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THE BRITISH ASSOCIATION MEETING AT SOUTHPORT.

(*From our Special Reporter.*)

THE fifty-third annual session of the British Association for the advancement of science, which was opened at Southport on Wednesday of last week, has been one of the most successful of the Association's long series of gatherings in the United Kingdom. The inaugural meeting was held in the pavilion of the Winter Gardens in the evening. The business of the Association was, however, commenced in the afternoon by a meeting of the general committee under the presidency of Sir William Siemens, the retiring president, at which the report of the council was submitted and approved. In the room of the late General Sabine and Mr. William Spottiswoode, Professor Lord Rayleigh and Sir Lyon Playfair were elected trustees of the Association. In Mr. Spottiswoode, the council and the whole Association, the report said, had lost one who was ever active in promoting its interests. Few men had been so deeply and deservedly lamented, for in him were united, to an exceptional degree, great mental powers, singular ability in practical matters, and a noble unselfishness. The council informed the Association that of the members who were present at last year's meeting four hundred and forty-five had notified their intention of going to the meeting at Montreal, and that fifty-five persons had either become members or had expressed a wish of doing so with a view of being present.

The officers of the present meeting were :—President, Dr. Arthur Cayley, Sadlerian Professor of Mathematics in the University of Cambridge and a Vice-President of the Royal Astronomical Society ; Vice-Presidents elect, the Earl of Derby ; the Earl of Crawford, eminent as an astronomer and as an electrician ; the Earl of Lathom ; Principal J. W. Dawson, of high scientific renown in Canada, and nominated by the Council on this occasion (probably in view of the intended meeting at Montreal next year) ; Mr. J. G. Greenwood, LL.D., Vice-Chancellor of Victoria University ; and Professor Roscoe, of Owens College, known for his chemical researches ; Treasurer, Dr. Williamson, of University College, London, of high eminence also as a chemist ; general Secretaries, Captain Douglas Galton, C.B., and Mr. A. G. Vernon Harcourt, a Vice-President of the Chemical Society ; the Working Secretary, Professor Bonney, a fellow of the Royal, Geological, and Antiquaries Societies ; Local Officers, the Mayor (Dr. Wood), Treasurer, and Mr. J. H. Ellis, Dr. Vernon, and Mr. T. W. Willis, Secretaries.

The presidents of the sections were as follows :—Mathematical and Physical Science—Professor Henrici, Ph.D., F.R.S., President of the London Mathematical Society ; Chemical Science—Dr. J. H. Gladstone, Ph.D., F.R.S. ; Geology—Professor W. C. Williamson, LL.D., F.R.S. ; Biology—Professor E. Ray Lankester, M.A., F.R.S., F.L.S. ; Geography—Lieut.-Colonel H. H. Godwin Austen, F.R.S. ; Economic Science and Statistics—R. H. Inglis Palgrave, F.R.S., F.S.S. ; and Mechanical Science—James Brunlees, F.R.S.E.

At the inaugural meeting in the evening, which was of a very attractive and brilliant nature, the body of the Pavilion and the galleries were crowded, and on the platform were a large number of distinguished members of the committee.

Sir William Siemens, the retiring President, in resigning the chair and introducing his successor, Professor Arthur Cayley, said it was a great satisfaction to him to see so large an assembly, as it showed that during the term of his office the interests of the Association had not materially suffered. The meeting at Southport promised to be a great success, and there were already indications that the meeting to be held in Canada next year would also be of a successful nature. In reviewing the Presidents' addresses during the past few years, everyone, he said, must have been struck by the great diversity of subjects which had been touched on. They had now approached a very high subject, and he had to introduce to them one of the greatest mathematicians of the age. In mathematics, as in every other science, there was poetry, and the President elect was a thorough poet in his branch of science.

Professor Cayley, who was warmly received, then delivered his address on mathematics, in the course of which, in regard to modern mathematics, he said :—It is difficult to give an idea of the vast extent of modern mathematics. This word "extent" is not the right one. I mean extent crowded with beautiful detail —not an extent of mere uniformity such as an objectless plain, but of a tract of beautiful country seen at first in the distance, but which will bear to be rambled through and studied in every detail of hillside and valley, stream, rock, wood, and flower. But, as for anything else, so for a mathematical theory—beauty can be perceived, but not explained. As for mere extent, I could perhaps best illustrate this by speaking of the dates at which some of the great extensions have been made in several branches of mathematical science. In conclusion, I would say that mathematics have steadily advanced from the time of the Greek geometers. Nothing is lost or wasted ; the achievements of Euclid, Archimedes, and Apollonius are as admirable now as they were in their own days. Descartes' method of co-ordinates is a possession for ever. But mathematics have never been cultivated more zealously and diligently, or with greater success, than in this century—in the last half of it, or at the present time ; the advances made have been enormous, the actual field is boundless, the future full of hope. In regard to pure mathematics, we may most confidently say :—

> Yet I doubt not through the ages on increasing purpose runs,
> And the thoughts of men are widened with the process of the suns.

The business of the Sections was commenced on the following day.

MATHEMATICAL AND PHYSICAL SCIENCE.

Thursday, September 20th.

ON EXPERIMENTS IN BOLOMETRY.

Professor Sylvanus P. Thompson read a paper on this subject. Hitherto, he said, the bolometers devised by Langley and others had been constructed of thin metal films, blackened with lamp-black or platinum-black. Abstract considerations showed that, to have a maximum degree of sensitiveness, the conductor employed should be one in which the change of electric resistance per degree of temperature was the greatest ; it should also have as small a thermal capacity as possible, and its capacity surface should be its only conducting part. Theoretically, therefore, a carbon film in some high compact form should be the best. Pending the preparation of special carbon filaments, he had the other day made some experiments on the strips and filaments of carbon which were to be found in incandescent lamps. The resistance of these, when carefully measured on a Kirchhoff's bridge, was found to be considerably less than when kept in the dark, the change of resistance in some cases amounting to 1 per cent. of the total resistance. The cylindrical filaments and rectangular strips used in most lamps were not, however, well adapted to show the bolometric effect, as their exposed surface was small as compared with the area of the cross section of the conductor. These observations suggested the following points : (1) That measurements made for specifying the resistances of such lamps should be conducted in the dark. (2) That a carbon film, or even a carbon lamp, might serve as the receiving part of a photophone. (3) That probably the facts obtained by Dr. Bernstein with metals might be re-observed if the metal films were very thin. (4) That special films of good conducting carbon should be applied in standard bolometers ; and (5) that a true standard photometer might be constructed on the bolometric principle, having a sensitive conducting film, covered with *pigmentum nigrum* from the human eye. Such an instrument ought to be sensitized to precisely the same rays as the eye itself, and in identically relative proportions for different rays.

SUGGESTIONS FOR FACILITATING THE USE OF A DELICATE BALANCE.

Professor Lodge submitted the following paper on behalf of Professor Lord Rayleigh :—

In some experiments with which I have lately been occupied, a coil of insulated wire traversed by an electric current was suspended in the balance, and it was a matter of necessity to be able to quickly check the oscillation of the beam, so as to bring the coil into a standard position corresponding to the zero of the pointer. A very simple addition to the apparatus allowed this to be done. The current from the Leclanche cell is led into an auxilliary coil of wire co-axial with the other, and is controlled by a key. When the contact is made, a vertical force acts upon the suspended coil, but ceases as soon as the contact is broken. After a little practice the beam may be brought to rest at zero at the first or second application of the retarding force. This control

over the oscillations has been found so convenient that I have applied a similar contrivance in the case of ordinary weighings, and my object in the present note is to induce chemists and others experienced in such operations to give it a trial. Two magnets of steel wire, three or four inches long, are attached vertically to the scale-pans, and underneath one of them is fixed a coil of insulated wire of perhaps fifty or a hundred turns, and of four or five inches in diameter. The best place for the coil is immediately underneath the bottom of the balance case. It is then pretty near the lower pole of the magnet, and is yet out of the way. The circuit is completed through a Leclanché cell and a common spring contact key placed in any convenient position. The only precaution required is not to bring other magnets into the neighbourhood of the balance, or at any rate not to move them during a set of weighings. The other point as to which I wish to make a suggestion relates to the time of the vibration of the beam. I think that with the view of obtaining a high degree of sensitiveness the vibrations are often made too slow. Now, the limits of accuracy depend more upon the smallness of the force which can be relied upon to displace the beam in a definite manner than upon the magnitude of the displacement so produced. As in other instruments whose operation depends upon similar principles—*e.g.*, galvanometers—it is useless to endeavour to increase the sensitiveness up to near an approach to instability, because the effect of casual disturbance is augmented in the same proportion as that of the forces to be estimated. If the time of vibration be halved, the displacement due to a small excess of weight is indeed reduced in the ratio of four to one, but it is not necessarily rendered any more uncertain. The mere diminution in that amount of displacement may be compensated by lengthening the pointer, or by optical magnification of its motions. By the method of minor reading such magnification may be pushed to almost any extent, but I am dealing at present only with arrangements adapted for ordinary use. In the balance by Oertling that I am now using, the scale divisions are finer than usual, and the motion of the pointer is magnified four or five times without the slightest inconvenience, by a lens fixed in a proper position. The pointer being in the same plane as the scale divisions, there is no sensible parallax. In this way the advantage of quick vibrations is combined with easy risibility of the motion due to the smallest weights appreciable by the balance. To illuminate the scale, the image of a small and distant gas flame is thrown upon it by means of a large plain lens. This artificial illumination is found to be very convenient, as the instrument stands at some distance from a window, but it is not at all called for in consequence of the use of the magnifying lens.

Friday, September 21st.

REPORT OF COMMITTEE ON ELECTRIC STANDARDS.

Mr. R. T. GLAZEBROOK on behalf of the committee said: The committee report that in accordance with suggestions made at the last meeting of the British Association, arrangements had now been completed for testing resistance coils at the Cavendish Laboratory and issuing certificates of their value. These arrangements have been made by Lord Rayleigh and myself, and the report contains an account by the latter of the methods employed and the conditions under which the testing is undertaken, in order that those who use the coils may have a more exact estimate of the value of the test. The standards of the laboratory belonging to the Association, the values of which have been recently tested, are all single units. The best of these were all compared among themselves by Hockin, British Association report, 1867, and again by Chrystal and Saunder, report, 1876, and at various temperatures between about O° C and 25 °C, by Mr. Fleming in 1879–1881, and a chart was constructed from which the resistance of any one coil at a given temperature between these limits can be determined. On this chart (*chart produced*) a curve is drawn for each coil; the ordinates of the curve represent the resistance, while the abscissæ give the temperatures. The temperatures, at which the various resistances were originally one B. A. unit each, are known for the respective coils. For these temperatures the ordinates of the curves drawn ought to be the same and the corresponding resistance one B. A. unit. Mr. Fleming finds, however, that this is not the case. The resistances of the eight coils examined at the temperatures at which they were originally said to be correct, are slightly different. The greatest difference is that between the coils marked *c* and *b* and amounts to ·0011 mean B. A. units. The mean of all these resistances at the respective temperatures is taken as the mean B. A. unit, and as to which the resistance coils sent for testing are referred. The coils examined are those marked as below in previous reports:—

A	B	C	D	E	F	G	Flat	1876
2	3	58	35	36	29	43	Flat	1867

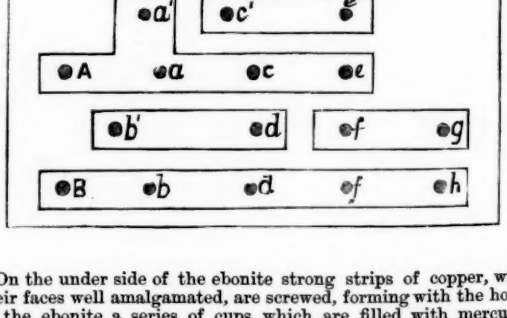
In comparing the single unit coils, the form of resistance bridge devised by Mr. Fleming and described by him (Proceedings of the Physical Society) is employed. The bridge with battery, keys and a suitable galvanometer is permanently fitted up in a ground-floor room with a north aspect. The standard coils are kept in a case in the same room and the baths in which the coils are to be immersed are always ready filled with water, which is thus at the temperature of the room. When a coil is to be tested, a suitable standard is chosen and the two are placed in the water baths and left for at least three or four hours—more usually overnight. The comparison is then made in the ordinary manner by Carey Foster's method (*Journal of Telegraphic Engineers*, 1874), and the coils again left for some time without being removed from the water. After this second interval another comparison is made. The temperatures of the water baths are taken at each comparison and, as a rule, differ very slightly. We thus have two values of the resistance of the coil to be tested, at two slightly different temperatures. The mean of these will be the resistance of the coil in question at the mean of two temperatures. We are thus able to issue a certificate in the following form:—

"This is to certify that the coil No. X has been compared with the British Association standards and that its value at a temperature of A° C is P B. A. units or P′ R—ohms, 1 B. A. unit being ·9867 R ohms."

We further propose to stamp all coils in the future with a monogram and a reference number. One single unit by Messrs. Latimer Clark, Warden and Muirhead, three by Messrs. Elliott Bros. for Prof. Mascart, and one by Messrs. Simmons & Co. have been tested. It will be said that nothing is said about the temperature co-efficient of the coil or the temperature when the coil is accurately 1 B. A. unit. To determine this exactly is a somewhat long and troublesome operation, but at the same time it is one which every electrician, if he knows the value of the coil at one given temperature, can perform for himself with ordinary testing apparatus. It does not require the use of the standards. For many purposes the approximate value of the temperature co-efficient obtained from a knowledge of the material of the coil will suffice; we may feel certain that any one requiring greater accuracy would be quite able and would prefer to make the measurement himself. We can state with the very highest exactness, that the resistance of the coil X at a temperature A° C is R. To obtain the temperature co-efficient accurately requires an amount of labour which may be quite unnecessary for the purpose for which the coil is to be used. But it is requisite to have standards of higher value than one unit, and part of the association grant has been used in obtaining coils of resistance of 10, 100, 1,000, and 10,000 units. Two of each value have been purchased, so that by frequent comparison of one with the other, any accident to either may be checked. It remains, therefore, to describe how these coils are to be referred to the standards. For the 10 units two methods have been adopted. There are at the Cavendish Laboratory two five unit coils. Each of these was compared with five single units placed in series, using Fleming's bridge to make the comparison, and the ten unit coil was compared with these two in series. The values obtained by two observers at a temperature of 12° were—

9·98360	Lord Rayleigh
9·98393	R. T. G.

For the second method, suppose we have three coils, each of resistance about three units, let them be $3 + \alpha$, $3 + \beta$, and $3 + \delta$, then the resistance of the three in series is $9 + \alpha + \beta + \delta$, and in multiple arc, approximately speaking, it is $1 + \frac{1}{9}(\alpha \times \beta + \delta)$, the resistance of the three in series is just nine times that of the three in multiple arc. But the three coils in multiple arc are very nearly one unit and can be compared with the standards. If, then, we combine in series with the same three one of the standards, we have a resistance of approximately ten units, whose value is very accurately known, and with which any other ten unit coil can be compared by the aid of Fleming's bridge, Lord Rayleigh has devised an arrangement of mercury cups by means of which the changes indicated can be easily performed. The three three unit coils are wound on the same bobbin and inclosed in the same case. The six electrodes project in pairs and their ends lie in a plane. The figure represents a piece of ebonite through which the holes are cut, as indicated by the letters *a*, *b*, &c.



On the under side of the ebonite strong strips of copper, with their faces well amalgamated, are screwed, forming with the holes in the ebonite a series of cups, which are filled with mercury. The copper strips are cut, as shown in the figure, to make the necessary connections. The distances between the holes is such that the electrodes of the three coils respectively fit into *a b*, *c d*, and *e f*, or into *a′ b′*, *c′ d′*, and *e′ f′*. Connection is made with the bridge by means of the cups, A, B, while the electrodes of the second single unit coil fit into *g* and *h*. In the first position the three coils are in multiple arc, as will be seen from the figure, that can be compared with a single unit; while in the second they are in series with the other single unit, and can be com-

pared with the ten unit. By this contrivance the ten unit is referred to the single standard. To determine the value of a coil of 100 units, the three 3 units can be replaced by three 30 units, and the single units by ten. This, however, is not the most convenient method, for the total resistance of the wire of the Fleming bridge in use is only $\frac{1}{30}$ of a unit, thus affording too small a range for the ready comparison of large resistances. The following has been adopted. Four coils are arranged, as in a Wheatstone's bridge, one being the 100 units to be tested, two of the others in opposite arms, two known ten units, and the fourth a known single unit. These coils are all arranged in the same circular trough of water, and their electrodes dip into four mercury cups. If all the coils are correct, no current will traverse the galvanometer. Of course, in practice, this condition is never realised. Either one of the ten units or the single unit is too great. Let us suppose it is the latter. Connect its two electrodes with the two electrodes of a resistance box, and take out plugs from this till a balance is secured; then, if the resistance of the two units be Q and R, that of the single unit, S, and shunt, W, the resistance of the shunted arm is $\frac{W S}{W + S}$, and that of the 100 units is $\frac{Q R (W + S)}{W S}$.

Now, in practice, if Q, R, S, are fairly accurate, W will be a large resistance, and an approximate knowledge of W will suffice. W may thus, for all we require, be taken from a resistance box by a good maker, which has stood for some time in the room in which the experiments are conducted, the temperature being taken as that of the room. A box has been ordered from Messrs. Elliott Bros. to be used for this and similar purposes. The same firm has also supplied a high resistance galvanometer for the testing. Of course, if one of the ten unit coils is too great, then the shunt, W, must be put in with it. In accordance with the resolution of the committee, a fee of £1 1s. has been charged for testing single units, and of £1 11s. 6d. for others. The only coils the testing of which is regularly undertaken are single units, and multiples of single units by some power of 10. But though this is so, two standard ohms have been ordered, using for the value of the B. A. ·9867 ohms, and when they arrive and have been tested it will be easy to determine the value of coils which do not differ much from a real ohm. The coils actually used in the recent experiments at the Cavendish Laboratory have a resistance of about ·1, 24, and 108 ohms; the operation is troublesome. The simplest accurate method seems to be to combine in multiple arc the real ohm and one of the 100 B. A. unit standards, and to compare the combination with a single unit.

Dr. Muirhead also reports the completion of three air condensers as standards of capacity.

The committee is glad to learn that Lord Rayleigh is continuing his valuable researches at the Cavendish Laboratory with the view of obtaining an absolute unit of current.

The committee would ask, in conclusion, that it be reappointed, with the addition of the names of Mr. H. Tomlinson and Professor W. Garnett, and that a further grant of £100 may be made to meet the expense of procuring standards of resistance in terms of the ohm.

MATHEMATICAL AND PHYSICAL SCIENCE.

Friday, September 21st.

ON THE "MAGNETIC SUSCEPTIBILITY AND RETENTIVENESS OF IRON AND STEEL."

By J. A. Ewing, B.Sc., F.R.S.E., Professor of Engineering in University College, Dundee. Read by Sir William Thomson in the absence of Professor Ewing.

During three years the writer has been engaged, while in Japan, in prosecuting researches in the magnetisation of iron and steel, and on the effects of stress on magnetic susceptibility and thermo-electric quality. Preliminary notices of some of his earlier results have appeared in the proceedings of the Royal Society (Nos. 214 and 216, 1881, and No. 222, 1882), but a detailed account of the work has still to be given. Meanwhile the following points, not previously noticed, are perhaps of sufficient interest to warrant their separate publication:—

In the experiments on magnetisation, iron and steel wires were used either welded into rings or in the form of straight pieces, whose length was great enough to make the influence of the ends negligible; curves were obtained in some cases by the Ballistic method, and in some by the direct Magneto-metric method, showing the changes of magnetisation which occurred when magnetising force was gradually applied, withdrawn, re-applied, reversed, and so on. The results of many experiments with several specimens of carefully annealed soft iron wires have shown that they possess in a very high degree a property not generally credited to soft iron—the property of remaining strongly magnetic when the magnetising force is removed.

As an example, the case may be cited of an annealed iron wire which was subjected to a magnetising force of 22·4 c. g. s. units. This gave a magnetic induction amounting to 16,000 c. g. s. units. When the magnetising force was removed, gradually and completely, the induction fell only to 1,500. In other words, the intensity of residual magnetisation was equal to nearly 1,200 c. g. s. units. Here more than 93 per cent. of the whole survived the removal of the magnetising force, and in many other cases the residual magnetism amounted to nearly 90 per cent. The somewhat extraordinary spectacle was thus presented of a piece of soft iron, entirely free from magnetic influence, nevertheless holding an amount of magnetism far in excess of what is ever held by a permanent magnet of the best tempered steel. In this condition, however, the magnetic character of the iron is highly unstable. The application of reverse magnetising force quickly causes demagnetisation, and the slightest mechanical disturbance has a similar effect. Gentle tapping removes nearly all the residual magnetism. Variations of temperature reduce it greatly, and so does any application of stress. On the other hand, if the iron be carefully protected from disturbance, it seems that the residual magnetism disappears only very slowly, if at all, with the mere lapse of time.

If, after magnetisation, the magnetising force be suddenly removed, the residual magnetism is, as might be expected, considerably less than when the force is removed gradually.

The ratio of residual to total magnetisation is always small when the intensity of magnetisation is small and passes a maximum, when the intensity is increased. This maximum is particularly distinct in wires which have been hardened by stretching, but it occurs also in soft annealed wires. In one instance where the wire had been hardened by stretching, the maximum ratio of the residual to total magnetism was 0·60, which was given by applying and removing a magnetising force of about 10 c. g. s. units, but on the application of a force of 90 units the ratio fell to 0·33. With steel, the maximum in this ratio is less sharp, but still distinct. Neither in hard iron nor in steel is the ratio even at its maximum so great as in soft iron, where, as has been said above, it frequently reaches 0·9.

During the first magnetisation of soft iron wires the ratio (κ) of intensity of magnetisation ($\imath$) to magnetising force was generally about 200—sometimes nearly 300—and by gently tapping the wire during the application of magnetising force, this co-efficiency was on one occasion raised to the enormous value of 1,590. In the case alluded to the magnetisation went on so rapidly as the magnetising force was increased that a force of 1 c. g. s. unit gave an induction of 10,000.

In this and other particulars the experiments have been strongly confirmatory of the idea that there is in soft iron a static frictional resistance to the rotation of the magnetic molecules, which is the principal cause of the remarkable retentiveness described above, and which is overcome by mechanical agitation.

Numerous measurements have been made of the energy expended in taking iron and steel through cyclic changes of magnetisation. For example, in exchanging the magnetism of one specimen of annealed iron wire from $\imath = 1{,}250$ to $\imath = 1{,}240$ and back, the amount of work done against magnetic friction (apart from any induction of currents) was 1,670 centimetre dynes per cubic centimetre of the metal. In hardened wire, and especially in steel, the work done is far greater.

The effects of stress on existing magnetism, and on magnetic susceptibility, have been examined at great length. The most remarkable effects occur in wires which have been hardened by stretching. In these the presence of a moderate longitudinal tensile stress increases the magnetic susceptibility immensely in low values of the magnetising force, but diminishes it in high values. It also increases very greatly the ratio of residual to total magnetisation, but both of these effects pass a maximum when the strength is sufficiently increased.

The whole subject is much complicated by the pressure of the peculiar action which in previous papers the writer has named "Hysteresis," the study of which, in reference both to magnetism and to thermo-electric quality, has formed a large part of his work.

MECHANICAL SCIENCE.

Friday, September 21st.

PATENT LAWS.

Sir Frederick Bramwell, F.R.S., submitted the following report of the committee on the Patent Laws:—The fact that an Act for the reform of the patent laws was passed in the Session just concluded, has of necessity thrown a good deal of work upon the committee. It has met five times, and nearly every member of it was present at one or more of the meetings. The following gentlemen have been added:—Sir John Lubbock, Mr. Alfred Carpmael, Mr. R. G. Webster, Q.C., and Mr. Theodore Aston, Q.C. Besides the Government Bill, which was introduced on the 19th February, the Bill prepared by the Society of Arts, and referred to in previous reports of this committee (see British Association "Report," 1881, p. 222, and 1882, p. 310), was again introduced by Sir John Lubbock, and Mr. Anderson also introduced a Bill generally similar to those he has brought forward in former years. The last two Bills were read a second time, but were not further proceeded with. After the second reading of the Government Bill, it was referred to the Grand Committee on Trade, by which some alterations of a more or less important character were made. The final stages were run through rather rapidly, and in one of the last weeks of the Session it passed through the House of Lords. The speed with which, after the long delay in the earlier part of the Session, the Bill was carried through Parliament, rendered it by no means easy to obtain amendment in it, and, indeed, the risk of the Bill not passing if many changes were introduced, afforded a reason to the President of the Board of Trade for not accepting many alterations pressed upon him from various quarters. It does not appear desirable to lengthen this report by giving an abstract of the Bill, since its main provisions have already been published in the technical newspapers and elsewhere. An excel-

lent summary is to be found in the Society of Arts *Journal* for September 7th, 1883. The committee felt that the Government Bill compared unfavourably with that of the Society of Arts, and this opinion was shared in many other quarters. Had the Government consented to accept that Bill, or had they at all events, been willing to adopt certain of its provisions, the committee believe that a much better measure would have resulted than they have any reason to hope the present Act will prove to be. On the whole, they are not sanguine as to any very beneficial results from the new law. The reduction of cost in the earlier stages of a patent has ensured the popularity of the Act in certain quarters, but it remains to be seen how far the actual process will be cheapened, and to what extent the new provisions for opposition, &c., will entail counterbalancing expenses. The substitution of a single working head, instead of *ex-officio* commissioners, is an obvious advantage, but the reform has not gone nearly far enough, for the new "Controller" is to be a mere departmental official subordinate to several distinct authorities, instead of possessing independent power. The provisions for applications for patents contain some minor improvements. A British patent is no longer to be affected by the duration of a corresponding foreign patent. The practice of "racing for the Seal," trying to get a later application sealed before an earlier one, is abolished. The system proposed for the examination of specifications is incomplete, and will probably be found to be of slight value, while it is very likely to give considerable additional trouble to the inventor. The provisions for opposition appear most objectionable, and will certainly press very hardly on the poorer class of inventors. Those for amendment and disclaimer are improvements on the present system. That the jurisdiction of the Privy Council in the question of the extension of patents is preserved, appears to the committee a matter for regret. The position of inventors as regards the Crown is somewhat improved, but it is manifestly unfair that the Treasury should be the tribunal to decide upon the terms on which the Crown may use inventions. This committee co-operated with the Patent Committee of the Society of Arts in endeavouring to improve the Bill, and in order to bring their views before the Government, they sought interviews with the President of the Board of Trade and with the Lord Chancellor; they believe their efforts have not been without good result. On both occasions time did not admit of their asking the sanction of the Council of the Association, and they therefore were obliged to go as a Committee merely, and not as representing the Association, or with the authority such sanction would have given, had it been obtained. Care was taken that this was definitely stated. The committee think it well that they should be re-appointed for the purpose of watching and reporting upon the working of the new Act. The committee would be glad if they could be allowed a grant of £5 to cover the various expenses, which otherwise (as in the past year) have to be defrayed by individual members.

GALVANI AND ANIMAL ELECTRICITY.

In the Winter Gardens, on Monday evening, Professor J. G. McKendrick, of the Glasgow University, delivered a discourse on the above subject. He said:—In these days, when electricity is commanding universal attention as a great force capable of being made subservient to humanity, it may be appropriate to consider some of the phenomena of electricity produced by living tissues and by living organs—or what is called animal electricity. We must also remember that most of the modern developments of electrical science may trace their origin to the physiological experiment of Galvani, the professor of anatomy at Bologna, in 1786. Struck by the contractions of frogs' legs in the vicinity of a frictional electrical machine, he wished to study the effects of atmospheric electricity, and accordingly made his first experiment. Then he discovered that there might be a contraction of muscle on the connection of the nerve and muscle by a heterogenous metallic arc. Then came the notion that the nerves conveyed electricity from the brain and cord to the muscles, and, following the law that the new concepts of a man of science originate from ideas of familiar things, the muscle was forthwith compared to a Leyden jar, the inner surface of which became positive by nervous action, whilst the surface was negative. Motion was caused by the irritation of a kind of discharge, the positive, internal, surface being connected with the negative, external, surface. Volta doubted this, and held that the phenomena observed by Galvani were due to very feeble currents of artificial electricity produced by the application of heterogenous metals to the limbs of animals. In a critical inquiry made by Volta into this question, he was led to the invention of the Voltaic pile, which not only for a time threw into neglect the question of animal electricity, but was also the starting point of the electrical science of the present day. In 1820, Oersted made the discovery of electromagnetism. This led to the invention of the astatic needle (Ampère), and of the multiplier or galvanometer (Schweigger); and in 1827 Nobili constructed a galvanometer of great sensibility, by which he could reinvestigate the question of whether or not currents of electricity could be obtained from animal tissues. He found that such currents did exist, and he supposed they were due to thermo-electric action. About 10 years thereafter (1837) Matteucci, of Pisa, again investigated the matter, and found that currents could be obtained from animal structures, even where all suspicion of thermo-electric or chemical action was removed. He also discovered that the interior of muscles was negative to their surface, and that it was possible to make a kind of battery of the thighs of newly-killed frogs, which could produce chemical effects similar to those caused by Voltaic elements. Then came the labours of Du Bois Reymond, the present professor of physiology in the University of Berlin, which will always mark the commencement of an epoch in the history of animal electricity. Recognising that the detection of the feeble currents from animal structures depended on the delicacy and accuracy of the apparatus employed, he made many improvements in the construction of galvanometers, and in the arrangements for leading off the currents from living textures into the galvanometer. Such galvanometers must be exquisitely sensitive, and it is evident that just in proportion as they are so, so will be the difficulty of making an arrangement which will lead off any current that may exist, say in living muscles, without causing a current itself. If we apply to a bit of muscle the ends of the copper wires coming from a delicate galvanometer we either get no effect or an effect due to the action of the muscle substance, or the fluid covering it, on the copper wire. We must have some arrangement which, while touching the muscle, will not cause any chemical change in it, and at the same time will draw off into the galvanometer circuit any current that may come from the muscle itself. That is, the electrodes of the galvanometer must be *non-polarizable*, even when touching muscle. Du Bois Reymond found that little troughs of zinc, filled with a saturated solution of sulphate of zinc, fulfilled these requirements. Into these are placed bits of blotting paper, also wet with sulphate of zinc solution, and on the bits of blotting paper are placed morsels of clay moistened with saliva. When the bits of clay are put into contact so as to make a circuit, no current passes through the galvanometer. If we now take a muscle from the back of the leg of a frog, cut it across, and place it on the clay pads so that the section of the muscle touches one pad and the surface of the muscle the other, a current of electricity passes through the galvanometer, as shown by the swing of the needle. This was shown by the lecturer, a beam from a lime-light being reflected on a screen by a mirror attached to the needles of the galvanometer. It was then shown that an uninjured frog's muscle gives no current; that no current can be got from two uninjured surfaces nor from two transverse sections; but only, speaking generally, when one clay pad touches a section and when the other touches a surface. This may be called the muscle-current. A similar current, though much weaker, can be obtained from living nerve. It was also shown that when a muscle is caused to contract, as it does naturally, the so-called muscle-current is diminished; at all events, suppose the current from the muscle brings the needle of the galvanometer to a certain point, if the muscle then be caused to contract, the needle will swing back to nearly its zero point. This reverse—the so-called negative variation—indicates that an electrical change in the muscle happens when it contracts. But by refined methods of experiment it has been shown that this change really occurs before the muscle contracts—that is, the change in the electrical state of the muscle is an expression of the chemical changes occurring in it, which are antecedent to the muscular movement. The lecturer further showed how it was possible to measure the amount of those changes by Poggendorff's method of compensation, by which a fraction of the current of a Daniell's cell was passed through the galvanometer in the reverse direction to the muscle current. Thus, it may be determined that the electromotive force of the natural current of a frog's muscle is about $\frac{1}{2}$ of a volt. Similar currents may be obtained from nerve, although they are very much weaker. Much discussion has taken place as to what these currents really mean; but the majority of physiologists agree with Hermann of Zurich in thinking that the current obtained on cutting or injuring the muscle or nerve is really due to the dying of the muscle or nerve substance at the point of section, and that the so-called "negative variation" is the current indicating functional activity. That is, living substance dies at the plane of section, and in dying it acquires a lower potential than the living matter, thus giving rise to a current. Again, supposing a living muscle giving no current, on stimulating it by irritating its nerve, so as to cause the muscle to contract, a lower potential is produced at the points in the muscle where the nerve fibres end, and there is thus a negative variation. Further, it has been shown that this negative variation passes like a wave through the muscle substance, and that the wave has disappeared before the muscle contracts. If, then, electric changes occur during the activity of muscle and nerve, it is natural that physiologists might expect to detect changes in the beating heart. This is the case. It was shown, by projecting its image on a screen, that the uninjured frog's heart, isolated from the body, still lives, and, whilst beating, gave with each beat an electrical variation, as shown by the swing of the galvanometer needle. The uninjured heart gives no current, but when slightly injured there is a variation in its electrical state with each beat. Then the lecturer showed that light causes an electrical change in the eye. Placing the eye of a frog in the galvanometer circuit, it was shown that there was a current passing from the cornea to the back of the eye. In the dark little or no change could be seen except what might be due to the drying of the living structures forming the eye; on allowing light to fall on the eye, there was at once an increase in the current. This continued for a time, then began to fall off, and, on light being removed, there was another decrease, and then a sudden and rapid fall off. This action, first shown by Professor Holmgren, Professor Dewar, and the lecturer, showed a specific influence of light on the retina. It could not be called a negative variation. It indicated chemical changes occurring in the retina. Lastly, the lecturer showed the production of currents from the living man. Placing the hands in two vulcanite troughs communicating by platinum plates with the galvanometer, and filled with a weak solution of salt, he

showed that on contracting one arm a deflection of the galvanometer needle was produced. When both arms were quiet there was no current; on contracting one arm a current was at once produced. This current the lecturer was inclined to think was due to action of the fluid on the skin, and not to currents from the muscles, and that the differences were due to differences of contact. In summing up, after a few remarks regarding electric fishes, the lecturer said that all of these electrical changes were really expressions of the vital changes occurring in living tissues under the action of stimuli. It was no part of the functions of nerves, muscles, or of the retina of the eye to produce currents under the action of their relative stimuli, but such currents indicated chemical changes in the organs or tissues; for example, the contraction of a muscle is a movement following or consequent upon many chemical changes, among the results of which were the production of heat and differences of electrical potential. Thus there was no special production of electricity, except in the case of electrical fishes, and possibly of some other animals. In most animals, including man, the production of currents was an incidental phenomenon, indicating chemical operations, and nothing more. Besides, the currents so produced were feeble and evanescent, and bore no relation to the general well-being. Consequently all attempts to influence the living body by magnets had no rational basis. The lecturer had tested this question by powerful electro-magnets, and had not been able to detect that they had the slightest influence on any vital phenomena. It need hardly be added that the so-called phenomena of animal magnetism are of an entirely different kind from those discussed. These are of a subjective character, dependent on peculiar states of the nervous system, having nothing whatever to do with electricity or magnetism, but still, in a sense, they are phenomena as real as those of physical science. Their subjective character, however, renders them specially difficult of investigation, and consequently they are more liable to fall into the hands of the charlatan. One safeguard against this is the recognition of what the electrical phenomena of the living body really mean, and one purpose of this lecture will be served if it shows that to detect and account for these phenomena requires the most refined methods of the physicist and of the physiologist, and that they give us only a glimpse into the intricate changes occurring in living tissue. The lecture was fully illustrated by experiments, in which galvanometers of the most sensitive construction were used.

(To be continued.)

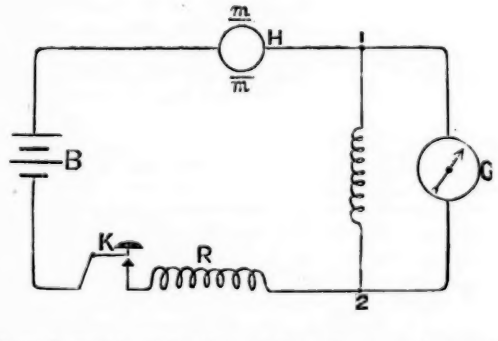
AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

THE three following papers, which we extract from *Science* of August 31st, were read in the Physical Section of the American Association for the Advancement of Science.

A METHOD FOR GALVANOMETER CALIBRATION.

By B. F. THOMAS, of Columbia, Mo.

A battery of any sort is joined in circuit with a sensitive galvanoscope, H, a galvanometer, G, and any variable resistance, R. When the circuit is closed at K, the current is so adjusted by varying R as to give the



highest desirable deflection of the galvanometer-needle. The needle of H will be forced against the stops. By means of magnets, *m* and *m*, the needle of H is brought back to zero. If these magnets and the galvanoscope be undisturbed the original current strength will be indicated when the needle stands at zero, whatever changes may have been made in the circuit. If now the shunt, S, be connected at 1, 2, and the resistance of the shunt is made equal to that of the galvanometer (positively determined), and the needle of H brought back to zero (by increasing R, as insertion of the shunts lowers the total resistance of the circuit, and therefore increases the current strength, deflecting H), a new deflection of the galvanometer needle will be produced, the deflection being that due to a current of one-half the strength of the original current. By giving to S values equal to ∞, 3, 2, 1, $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, &c., times the resistance of G, and bringing the needle of H to zero each time, deflection of G will result, due to currents whose strengths are as 1, $\frac{3}{4}$, $\frac{2}{3}$, $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{5}$, &c. The curve is then plotted with deflections and current strengths as coordinates. Any desired number of points in the curve may be obtained by giving S the proper values. The calibration may be checked by making a new adjustment for the united current, so that the deflection of G shall be about two-thirds the first deflection, and proceeding as above. Plotting the new values obtained, the curves will coincide if the work is correct. If it be found desirable the battery may be exchanged for another during the determination.

NEW FORM OF SELENIUM CELL.

By C. E. FRITTS, of New York.

Prof. MENDENHALL stated that in the absence of the author he was able to give only a brief summary of the paper. In the ordinary method of making selenium cells they are constructed of a great many portions put side by side; the resistances are necessarily very high in these cells, and the light is allowed to strike in the direction of a right angle to the direction of the passage of the current. Mr. Fritts seems to have devised a different mode of operating these cells by using a very large surface, and in that way has succeeded in diminishing the resistance very greatly, which is very desirable. He has resistance as low as 9 or 10 ohms in the dark. The radical point of difference is, that in this case the light is allowed to strike upon the cell in the same direction as the current. He states that he has discovered many remarkable properties by means of his investigations with the instrument. When a cell of this kind breaks down it can easily be remedied and repaired; in fact there is no danger or difficulty of their breaking down permanently.

THE STATIC TELEPHONE.

By Prof. A. E. DOLBEAR, of College Hill, Mass.

In the static telephone, a ring of hard rubber is used, within which are two parallel metal plates separated by a body of air (a non-conductor) one plate connected with the line carrying the current. The electrifying of one plate then causes attraction or repulsion of the free plate, and thus a sound in the receiver. This does away with magnetism. This system therefore requires a very large electromotive force, and uses an induction coil of 2,000 ohms. A ground or return circuit is not present here. The equivalent is the body itself. There is no passage of electricity from plate to plate: the action is purely inductive through space. The insulation is accomplished by the intervening air space, and by a coating of varnish—an excellent di-electric. There is a device to discharge the induction plate in connection with this instrument, which keeps it constantly up to its full possibilities. When this instrument is fully charged, and the electrical conditions are perfect, the receiver may be entirely disconnected from the transmitter, and the sounds and conversation can still be heard, even across a room.

He also called attention to the fact, that instruments that have been in use work much better than new ones, as each plate acts as a condenser.

In the discussion which followed, Dr. Dolbear was asked if the state of the atmosphere, in any way, affects the operation of the instrument. I have used these instruments, said he, on an actual line between Boston and New York, on a night when it rained over the whole length of the line, and the whole line was as badly insulated as it well could be. I have also used it on the same line under the most favourable conditions for insulation, and could not really perceive much difference. It seemed to be as loud at one time as at another.

President H. A. ROWLAND: Of course this is on an entirely different principle from our telephone. What interested me considerably was the fact, that one could hear better when the plates were charged. The explanation theoretically is very simple, and it is the same as that the Thomson electrometer is more sensitive when the jar is charged than when it is not charged; the reason being, that the attraction is proportionate to the square of the difference of the potentials, rather than the simple difference of the potentials. Therefore a small difference in the quantity, when it is large, produces a greater effect than when it is small. So the explanation is exactly the same as that the Thomson electrometer is more sensitive when you have the jar charged than when you do not. So, the higher the charge one would get, the more sensitive the instrument would be. I was especially interested in it, because it was on such an entirely different principle from the Bell instrument. I don't wish to say anything about patent laws or decisions on this subject, for they have nothing to do with this; but, scientifically, this is an entirely different instrument from the Bell instrument, and I am especially interested on that account.

Prof. T. C. MENDENHALL: I profess not to have quite understood the statement made by Prof. Dolbear. I should like to hear your own (the president's) opinion with regard to that charge which remains in spite of the fact that the two poles of the condenser are connected by conductors. I may have misunderstood the statement; but if that is correct, I should like to know whether that can be explained or not.

President ROWLAND: Well, I suppose we all know how retentive an electroscope is of a charge. I suppose the idea is very similar in this case. I do not suppose the plates have a difference of potential. If you should leave them for a moment, I should suppose they would soon have a little return charge. If the two plates of the condenser were together, they would have the same potential. I understood it as merely a return charge. I do not know how Professor Dolbear understands it.

Prof. DOLBEAR: The instrument itself is a most delicate electrometer when tested in this way; and when it is charged and really in good working order, the gentlest tap upon the instrument serves to show that it is in good working order, for one can apply the instrument to his ear and hear himself talk. This is the case, even when the two plates of the condenser are connected with each other through the induction coil; and so, although they may have been there for hours, or even for days—the difference between an instrument that has not been used and one that has been charged is very appreciable.

President ROWLAND: I suppose in that case it would be simply from the charge of the varnished surface?

Prof. DOLBEAR: Yes; I think they retain their charge for a much longer time if the surface is varnished. I do think there is a difference between the behaviour of this and the charged cable. If a cable be charged for half an hour by battery, it will require half an hour to run out again, but it will be at that time quite discharged. But that is not the case with this instrument.

President ROWLAND: I should suppose it was the charge in the varnished surface.

Prof. W. A. ANTHONY: Professor Dolbear did not say anything about one advantage that this telephone has over the other, that struck me when I read the descriptions of it earlier—that, in consequence of using this electricity at such a high potential, the ordinary telegraph lines or other instruments would have very little effect upon it: therefore the telephone is very free from induction.

Prof. DOLBEAR: My experience has been in accordance with that theory. Electromotive force from induction from telegraph-lines is ordinarily tolerably small, although there may be at times considerable strength of current. But, the electromotive force being so strong in my circuit, it follows that the action of such induced currents is very slight, and does not interfere with work.

Prof. C. A. Young: I would like to inquire whether you have tried any experiments in putting the end of the wire to the ear to illustrate the sensitiveness of the ear?

Prof. DOLBEAR: Yes; I have heard simply by putting the end of an insulated wire to my ear, and listening. I consider the instrument as simply the enlarged terminal of a wire, and that you are actually listening at the end of a wire.

Mr. E. GRAY: I have made a good many experiments in another line, which I may state briefly, which may throw some light upon this, and yet I think it is very well understood. You remember, some of you, reading of such experiments made in 1874, relating to the reproducing of music on a plate by simply rapping with the finger or with some animal tissue. Now, I made this experiment, which seems to prove to my mind that the operation is as Prof. Dolbear has explained it. I set my revolving disc, which was a simple disc of zinc, revolving at a steady rate, giving it a pressure with the fingers. Then I had fifty cells of battery set up, as much as I could bear, passing through them, and had some one close the circuit with a Morse key. At the same time the key was closed, my finger would be jerked forward in the direction of the rotation of the disc: and it would remain in that forward condition, showing an increase of friction, until the key would be opened, and then it would drop back; showing that from some cause there was an increase of friction, either due to molecular disturbance, or, what is probably the case, to attraction between the finger and the plate. It is necessary, to produce this experiment, that the cuticle be perfectly dry. You must rub it a long time, and have it perfectly polished; and then the cuticle becomes a dielectric, and the body is charged with one kind of electricity, and the wire or the plate with another. Later I got some fairly good results in articulation by using a small diaphragm with all the conditions as nearly right as possible; and, having a current of sufficient electromotive force, I could actually understand words produced on the end of my finger.

President ROWLAND: What is the difference between that and Edison's motorphone?

Mr. GRAY: In Edison's motorphone, when the current was thrown on, there was a decrease of friction; there was chemical action taking place on the surface. In this case there is none, and there is an increase of friction when the current is on: perhaps "current" is a bad word to use.

President ROWLAND: The principle is the same.

Mr. GRAY: One is a chemical action, which causes the friction to be less at the moment of charge. In this case, however, this is purely static contact, and increases the friction in the same manner that the plates are thrown together when they are charged in this telephone. And the motion, of course, or sound, is produced by a letting-go of the finger from the plate, and not by actual vibration, in the same sense that it takes place between the two plates in this receiver of Prof. Dolbear.

President ROWLAND: You attribute it to attraction?

Mr. GRAY: Yes; my experiments seem to prove that; I presume, because there was adhesion, there was an increase of friction during the time of the charge and the letting-go, when the circuit was open. There was really no circuit except when the charge was taken off.

Sec. F. E. NIPHER: In regard to the case of which Prof. Dolbear spoke, when it might be supposed that electricity does actually pass from the line into the ground, it seems to me that that fact, so far as it did exist, would be prejudicial to the action of the instruments; that what we want to bring about is not a current, but as great a difference of potential as possible between the plates.

Award.—Messrs. Ruston and Proctor, the well-known engineers, have received the "Diploma of Honour" at the Amsterdam Exhibition.

REVIEWS.

A Physical Treatise on Electricity and Magnetism. By J. E. H. GORDON, B.A. Second edition. Revised, re-arranged, and enlarged. In 2 vols. London: Sampson Low, Marston, Searle, & Rivington, Crown Buildings, 188, Fleet Street.

The principal changes in the new edition of this admirable standard work consist of the correction of a few errors which existed in the old edition; also the re-arrangement of some of the chapters; and, lastly, the introduction of a considerable amount of new matter. The principal additions consist in an account of Mr. Tribe's electrolytic experiments, which are illustracted by facsimiles of the beautiful copper deposits on silver plates prepared by him. Full descriptions of Professor Bjerknes' and Mr. Stroh's classic apparatus for showing the curious analogies between mechanical vibrations and electric and magnetic phenomena are also given. New experiments by Mr. De la Rue and M. H. Bergneul will likewise be found. The new coloured plates describing Mr. Tribe's experiments are very fine; indeed, the whole of the illustrations are excellent, and no pains have been spared to make them as complete as possible. Mr. Gordon's book, on the publication of the first edition, at once became a standard scientific work, and the new edition has followed almost as a matter of course; but nevertheless the additions which it contains have rendered the work more valuable and interesting than ever.

The Chemistry of the Secondary Batteries of Planté and Faure. J. H. GLADSTONE and ALFRED TRIBE. Macmillan & Co.

This book is a reprint of the articles which originally appeared in our contemporary *Nature*, and were immediately afterwards republished in the ELECTRICAL REVIEW. The little volume is a valuable contribution to our knowledge of secondary batteries and deserves to be widely circulated.

*The Edison Glow Light and its Importance in Hygiene and the Saving of Life.** Berlin: Julius Springer.

This pamphlet is a publication of the German Edison Company. It opens with showing how greatly the air of rooms, public and private, is deteriorated by gas lights, and to what a degree the temperature is raised. According to a calculation here given, a glow light of the power of 100 normal candles liberates in an hour heat equal to 290—536 calories, whilst the same quantity of light obtained from gas-burners involves the production of 12,150 calories. The writer overlooks, however, a very important consideration which would have materially strengthened his case. The heat evolved by gas, and to some extent by petroleum lamps, is annoying and hurtful, because it affects the upper part of the room more than the region near the floor. In other words it tends to make the head of every person present hotter than his feet, a most antisanitary condition. In various trades, &c., where the artisan requires a powerful light thrown upon the objects with which he is engaged, the head, and the eyes more especially, are undoubtedly injured by the close proximity of such sources of heat as gas flames, petroleum lamps, &c. This annoyance is so great that many persons restrict themselves to a minimum of light, thus injuring their eyesight as certainly, though in a manner not so immediately perceptible. Attention is next called to the possible, or rather certain production of injurious gases which escape into the room. Here gas enjoys a bad pre-eminence. The quantity of carbonic acid which it gives off for an equal amount of light is not, indeed, excessive; but, on the other hand, it yields sulphurous acid, sometimes small quantities of sulphuretted hydrogen, sulphuret of carbon, and even ethylene. All these products are unfavourable to human health, and sulphurous acid has in addition a destructive action upon paintings, books, paper-hangings, many kinds of textile goods, articles of steel, brass, &c. Hence coal gas is of all sources of light the worst for shops, warehouses, &c. There is also the possibility of gas escaping unburnt; a jet left carelessly half-open, a badly-soldered connection, a porous piece of piping, or a chink caused by the subsidence of the foundations—no uncommon accident in modern houses—may prove not merely injurious, but deadly. From all these evil properties the incandescence light is free, not merely partially or conditionally, but absolutely. Oil lamps are far better in these respects than gas, but even they give off occasionally an unpleasant odour.

The colour of the glow light has a further advantage as compared with other modes of lighting. So far, it makes the nearest approach in quality to that of the sun. Gas light is too red, the arc light too violet, whence the frequent and not unfounded charge of ghastliness brought against it. All three, however, as compared with sun light, are deficient in the blue ray.

As an especial advantage of the glow light is claimed its freedom from the unpleasant and sight-destroying defect of flickering and jumping. Gas lights, it is well known, are never absolutely steady; the arc light, as is well known, is guilty of strange vagaries, but the glow light rivals in steadiness the flame of a well-trimmed paraffine lamp in a room free from draughts.

In the last section of the pamphlet the author lays great, but not undeserved, weight upon the safety of the glow light in comparison with gas. The latter has proved itself a most fruitful source of conflagrations in theatres and shops. The tragedy at the Ring Theatre in Vienna is still fresh in the public mind, but its lessons are practically ignored. It is not without a shudder that we see in the windows of shops naked gas flames sometimes within a couple of inches of filmy, combustible tissues. A current of wind, or a false movement on the part of an assistant, and the crisis is reached. As for oil lamps, not to speak of the fearful occurrence at Santiago some years ago, the domestic fires and explosions which it occasions in careless hands are of almost daily occurrence. But with the glow light, if the fittings are properly arranged at the outset, we have an absence of danger nearly perfect.

To a very great extent, if not entirely, we can agree with the author's contentions. But, of course, the question arises in how far the advantages claimed are peculiar to the Edison system or are rather common to glow lights in general? Upon this point the pamphlet is silent, an omission which gives it too much the character of a trade circular issued on behalf of the German Edison Company.

* *Das Edison Glühlicht und seine Bedentung für Hygiene und Rettungs Wesen.*

ELECTRO-MAGNETIC FRICTION FOR MOUNTAIN RAILWAYS.

By A. WILKE.

THE idea of increasing the friction of the wheels of a locomotive when ascending a steep gradient by means

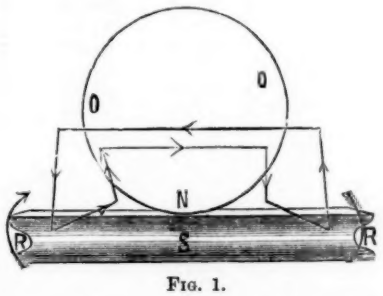


FIG. 1.

of electro-magnetism is not novel. But as I have not yet seen this idea put into a practical shape, I may hope that the following construction will not be without interest for the reader:—

Fig. 1 represents the course of the current and the

magnetic distribution. The current passes horizontally round the wheel O, N, O, converting it into a magnet which stands with its north pole upon the rail, R, S, R. The current is led further in such a manner that it passes on both sides of the wheel, close over the rails. Thus these are also magnetised in such a manner that at the point, S, where the wheel and the rail touch, there is formed a south pole. The result is a very considerable increase of the adhesion between the wheel and the rail.

Fig. 2 shows the friction arrangement for three wheels. A copper or bronze frame supports the coils of wire which are spread out at the parts where the wheels pass over the rails and partly enfold them.

The magnetisation is effected by a dynamo machine which derives its power either from the axle of a wheel or, as is preferable, is driven by a small special engine.

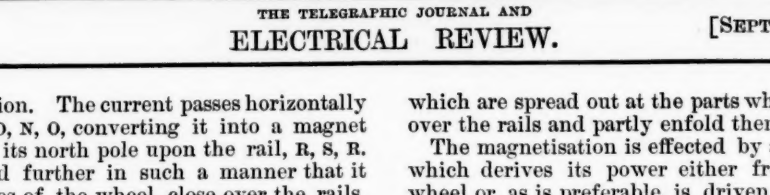


FIG 2.

The application of this electro-magnetic friction is, of course, easiest in electric railways, and as these are to be recommended in mountainous districts on other grounds, the electro-magnetic friction will increase their advantages.—*Intern. Zeitschrift Elect. Austellung. Wien.*

TESTS ON INCANDESCENCE ELECTRIC LAMPS.

THE following tables which we extract from our contemporary, *La Lumière Electrique*,* give the results of the tests made on various incandescence electric lamps, at the recent exhibition held in Munich, as compared with those of the Paris Exhibition of 1881. A peculiarity in the Cruto lamp is, that its resistance *increases* with the current strength, an effect which certainly cannot be beneficial to the economical working of the lamp.

RESULTS OF THE MUNICH COMMITTEE.

Lamps.	Mean spherical luminous intensity in normal candles.	Resistance when hot in ohms.	Difference of potential in volts.	Current in ampères.	Electrical Work in		Mean spherical intensity per H.-P.	Number of Lamps per H.-P.
					Volt ampères.	H.-P.		
Edison B	11·69	67·68	55·78	0·825	46·02	0·0625	186·90	23·36 (8 candles)
„ A	15·32	139·60	103·05	0·755	77·80	0·1057	144·88	9·05 (16 „)
Maxim	13·34	47·01	65·07	1·384	90·06	0·1224	108·98	3·89 (28 „)
Swan A	10·95	31·91	38·38	1·222	46·90	0·0637	171·78	17·18 (10 „)
„ B	37·17	87·03	118·02	1·282	151·30	0·2056	180·75	4·52 (40 „)
Siemens	14·90	104·72	95·74	0·915	87·60	0·1191	125·14	7·82 (16 „)
Muller A	18·43	58·62	74·04	1·263	93·51	0·1271	145·01	7·26 (20 „)
„ B	43·08	59·52	105·22	1·779	187·19	0·2544	169·33	3·39 (50 „)
„ C	102·35	65·41	155·15	2·367	367·24	0·4991	205·05	2·05 (100 „)
Cruto	8·47	8·16	22·15	2·715	60·14	0·0817	103·58	10·36 (10 „)

RESULTS OF THE COMMITTEE OF THE EXHIBITION OF 1881.

Edison A	15·38	137·4	89·11	0·6510	57·98	0·0788	196·4	12·28 (16 candles)
„ C	31·11	130·03	98·39	0·7585	74·62	0·0941	307·25	9·60 (32 „)
Swan A	16·61	32·78	47·30	1·471	69·24	0·0945	177·92	11·12 (16 „)
„ B	33·21	31·75	54·21	1·758	94·88	0·1059	262·49	8·20 (32 „)
Lane-Fox A	16·36	27·40	43·63	1·593	69·53	0·1025	173·58	10·85 (16 „)
„ B	32·71	26·59	48·22	1·815	87·65	0·1289	276·89	8·65 (32 „)
Maxim A	15·96	41·11	56·49	1·380	70·85	0·1191	151·27	9·45 (16 „)
„ B	31·93	39·60	62·27	1·578	98·41	0·1337	239·41	7·48 (32 „)

THE EFFECTS OF LIGHTNING.

A MOST unusual and extraordinary occurrence took place at Dinnington Colliery, the property of Messrs. John Bowes and Partners, a few weeks since, during a thunderstorm. Lightning seemed to strike the west winding-rope of the west shaft in its elevated position upon the pulley. It passed down into the winding engine-house, where it was seen to flash up and down the feed pump, below the level of the floor, and quite illuminated the place at the time; another flash passed down the rope to the bottom of the shaft, a depth of thirty-five fathoms, striking the cage, which fortunately was standing upon the bottom at the

* Our Contemporary's figures do not appear to be correctly worked out in all cases.—EDS. ELEC. REV.

time. The onsetter describes it as like a ball of fire falling upon the iron flat sheets at the bottom. He had his hand upon the cage and received a smart electric shock, and was nearly blinded by the flash for the moment, but fortunately received no personal injury. The shaft is fitted up with round wire rope guides for two cages; these guides are suspended from the top of the pulley frames or "head gearing," and secured at the bottom by heavily-weighted levers. These iron rope guides, says the *Newcastle Chronicle*, would probably act as lightning conductors, and thus lessen the shock of any excess of electric fluid by carrying it off into the "sump." Had the cages been running in the shaft at the time, and the shaft fitted up with the usual wooden guides, serious damage might have been caused, which would have been most difficult to account for or explain. After careful examination of the frames, pulleys, rope, shaft, &c., no injury could be detected.

The following criticism of the lightning rod, from the pen of Colonel Parnell, late Royal Engineers, appears in the *Chronicle* of the 14th ult.:—"In your article on the recent lightning incident at Dinnington Colliery it is stated that 'one means of preventing such disasters that this accident suggests is the provision of carefully placed lightning conductors in the close vicinity of the pit mouth.' Will you allow me respectfully to submit to your readers my strong conviction, after several years' special attention to the question of the defence of property from lightning, and after compiling nearly 700 detailed records of lightning accidents, including 124 instances of the failure of 'lightning conductors,' that these instruments are mostly contrivances for inviting lightning to buildings. In a case like that of a pit's mouth, where cage, guides, winding ropes and head gear already contribute a mass of attractive metal, the addition of a 'lightning conductor' (especially if of copper) would be simply adding fuel to fire. By all admitted electro-static laws the whole of the stalk or exposed portion of a lightning rod (if I may use the original and correct term for these apparatus) is simply an accumulator of electricity. It thus, like all other metals connected to the ground, tends to collect charge, and since charge is the cause of discharge, it tends to produce discharge—*i.e.*, lightning explosion. Speaking, then, in a rough and popular sense, a lightning rod in good order, namely, well connected to the ground, *tends to invite lightning discharges to a building*. If the rod be *not* properly connected to the ground, it is in the same category as a piece of detached metal on the outside of a building, and is even more deadly than before in its attractive effects, for it has now the power of drawing to itself the explosion resulting from the charge already collected in the ground below, and hence of occasioning great damage to any masonry or other non-conducting material that may intervene. It is impossible within the compass of a letter to elucidate satisfactorily the physical action of a lightning stroke; but I think, Sir, that your readers may feel assured of this one simple fact, viz., that metal in any shape or form, whether on a building or on the masts of a ship, or at the shaft of a coal pit, or among the clothing of a person, or, briefly, in any conceivable situation above grouud, is, *qua* lightning strokes, a *source of danger*. I have the less diffidence in trying to impress your readers with this unquestionable fact—with this lesson that Nature manifests with unerring precision in all countries and at all times, inasmuch as the same idea is already deeply rooted in the minds of a proportion of quite 999 persons in 1000 in the United Kingdom. Very few educated persons indeed, besides professed 'lightning conductor' advocates and 'electricians,' *i.e.*, persons interested in the manufacture or in the manipulation of electrical instruments, will say a good word for lightning rods; and (apart from manufacturers) the number of private individuals in this country who employ these contrivances is infinitesimal.

"But with all this heavy drawback, there is still one portion of a lightning rod (though this portion is sometimes dispensed with by 'electricians') that is really useful, provided always that the rod be well connected to the ground. I allude to the *point* that usually surmounts it. Electrical laws, thoroughly well established, tells us that points or even mere corners and angular prominences tend to eject charge gently and gradually from metallic surfaces where it may have accumulated. Thus the angles of a charged piece of a metal will sooner or later disperse all the electricity on it. But—and here is the fatal disadvantage appertaining to all metals charged with terrestrial electricity—it is quite possible that a piece of metal may receive fresh charge at a quicker rate than any angle or points on it can disperse this charge, and hence explosion ensues in spite of the preventive power of the points. Lightning rods are thus dangerous *electric taps*. Their stalks or exposed parts are accumulating as rapidly as possible the fearful charge that causes lightning whilst their points are manfully striving to disperse this terrible element before it can reach an explosive stage. The stalk is, as it were, generating steam, whilst the point is acting as a valve. The late Professor James Clerk Maxwell, in a paper read by him in 1876 at the British Association, distinctly announced his agreement with the above-mentioned views, and the term 'electric tap is, I believe, due to him.

"Now, my contention is this. Why generate this steam at all? Surely Nature supplies us of her own free will with a sufficiency of disastrous lightning strokes or thunder-bolts without any moral obligation being laid on us—on human beings, let alone civilized human beings—to aid in this work of destruction and death. Why not exert our efforts *solely* to tap and disperse, in the most economical manner, this deadly thunder-bolt electricity which accumulates under our feet? Why not, in fact, try to *prevent* lightning strokes, instead of endeavouring, as the 'electricians' do, to produce them first and to ward them off afterwards? For it is to be noted that this power of points to disperse charge, however much it may be agreed to in theory, is but little honoured in practice. There is hardly an 'electrician' in this country (let it be understood that I am using this term in contradistinction to that of physicist) who believes that the action of lightning is other than that of a sort of stream of 'electric fluid' descending from the clouds (where they hold that it is generated) to the earth. Their theory is that the prominent upper part of the lightning rod attracts and intercepts this fluid, and that the rod then 'conducts' it harmlessly into the ground, where in some mysterious manner it is supposed to disappear. They allow in a casual manner that the rod's point *may* do good, but they look on its function as entirely secondary.

"Now, if the close analysis of actual lighting accidents be given weight, and if the actual manifestations afforded in the laboratory by the operations of electric sparks be not deemed a dead letter it is (as I said in a former letter) almost a certainty that all lightning strokes are generated on the ground, and that they spring upward therefrom. Thus at Dinnington Colliery, the charge that caused the stroke probably collected in the ground at the bottom of the shaft (close to the onsetter whilst he was holding the cage), and the lightning discharge or thunderbolt sprang upward therefrom, and from the metal guide ropes which had acted as accumulators, and passed through the 'head gearing' in its course; and very possibly a simultaneous, separate stroke sprang from the floor of the engine-house; but without seeing the place, it would be difficult to form an exact opinion on this latter point.

"In reply to my views, it may perhaps be urged (though hardly by scientific men) that the fact of a great number of church steeples and boiler chimneys that are fitted with lightning rods not having been struck is a proof that these rods are efficient 'protectors.' But we can no more *absolutely* cause thunderbolts than we can *absolutely* prevent them. What we really *can* do, however, is to place a building or other construction in a position *tending* to cause, or *tending* to prevent lightning strokes. The steeples and chimneys are 'protected' (to use the somewhat quack expression

generally in vogue) from lightning, not on account of their rods, but in spite of them. There are many other conditions that go to form lightning strokes besides metallic ones. The 'Old Hall' at Lumley, which I examined last June, just after the lightning accident had occurred there, had very little metal about it—in fact, none at all on the outside of the building—yet it received a terrible blow. On the other hand, her Majesty's prison at Leeds, which was struck on the 12th of last month, presented an excellent metal channel from the ground, by means of a rain-water pipe and the lead guttering of the roof, to the base of one of the ornamental turrets, whence the bolt darted upwards like a knife, right through the massive stone blocks with which the turret was faced to a small isolated lead shoot on its roof, whence, with a parting blow at the parapet, it rushed aloft to meet its eager partner from the cloud. These two cases at Lumley and Leeds evinced the clearest tokens of an upward force. I may mention that the great central tower of Leeds prison (much higher than the turret) is fitted with a lightning rod; and this rod was quite unsuccessful in the *role* that 'electricians' would have allotted to it; for, instead of attracting the lightning to itself and 'protecting' the building, it was (as it were) unnoticed by the thunder-cloud, which preferred to condense the charge at the foot of the rain-water pipe near the base of the turret.

"I must conclude with an apology for the length of this letter; but the great interest I take in these matters, and the earnest hope I cherish that manufacturers, colliery owners, and church authorities may be induced to use their own judgment in deciding on the policy to adopt in defending their property from lightning must be my excuse,"

[Col. Parnell certainly has the courage to express strong opinions; perhaps some "Electricians" might feel inclined to reply.—EDS. ELEC. REV.]

ARTIFICIAL LINES.

IN our correspondence columns last week, we said, in replying to the letter of Mr. Frederick H. Varley, that we would publish that portion of Mr. S. Alfred Varley's paper, read before the Society of Arts in 1859, in which he had so minutely described an arrangement for an artificial line. As this subject will probably form a theme of interest to the majority of our readers, we herewith give the extract to which we have referred :—

"The amount of retardation which will be experienced in submarine circuits possessing conductors of varying resistance, and insulated with different thicknesses of insulating material, it appears to me can (comparatively speaking) be readily determined by actual experiment.

"I have for a long time been engaged in designing an apparatus for this purpose, and at the time I arranged to give this paper I fully expected to have had the apparatus completed, and to have been able to lay it before you on this occasion, and though I regret not being able to do this, yet I feel I have sufficiently advanced to warrant my explaining the principles of its construction.

"The principles upon which it is based are—that a body which offers the same resistance as another, without reference to its substance or length, may, as far as conducting power is concerned, be considered electrically the same. If we make use of a substance or metal of any inferior specific conductive capacity to that of the metal employed in submarine circuits, and also of greatly diminished sectional area, the same resistance as that offered by the very longest circuits can be obtained in a very small compass, and such an arrangement will, as far as simple conducting power is concerned, fairly represent a long submarine circuit.

"The induction which manifests itself in submarine circuits can also be obtained if the conditions for its development are as favourable as they are in submarine conductors.

"The apparatus consists—

"1st. Of a series of resistances, the values of which are known.

"2nd. Of a series of induction plates, the values of which, when compared with a given surface of a gutta-percha coated wire, are also known.

"3rd. A mechanical arrangement to accurately measure minute periods of time.

"By a combination of the resistances and the induction plates, a conductor which will fairly represent a submarine circuit will be obtained.

"The resistance can be diminished or increased, and the inductive surface can be doubled or halved at pleasure, and thus circuits with conductors of varying length and sectional area, and different thicknesses of insulating material, be imitated, and the law which governs the retardation in the transmission of telegraphic signals determined by direct experiment.

"It may be argued that as the inductive surface in a telegraphic circuit is uniformly spread throughout, a series of induction plates will not present the same conditions, but it is evident they may be divided throughout also, and although they will not then precisely represent what is actually the case, the result will approximate very closely to those obtained from a submarine conductor.

"Perhaps it would have been prudent not to have called attention to an apparatus before its completion. I have done so, however, because I have felt it was due from me to endeavour, at least, to point out how some of the important problems involved in submarine telegraphic communication between distant stations may be resolved."

After a discussion, in which Messrs. C. V. Walker, Cromwell Varley, C. W. Siemens, Leonard Wray, and Professor Tyndall took part, the Chairman, W. Fothergill Cooke, Esq., expressed his opinion, in the following terms, on the result of the discussion. He said they had advanced very little in practical knowledge since the failure of last year with the Atlantic cable; but the proper way of doing so was to follow the course pointed out by Professor Tyndall. At the same time he thought it was well that theories should be advanced with a view to set men thinking; but the Professor no doubt meant to pay Mr. Varley the compliment that his knowledge of this matter would be better applied to the practice than the theory of the subject. But Mr. Varley was, in fact, doing what had been asked of him; and it was only owing to some delay in the completion of an elaborate instrument that he was not able to lay before them the results of actual experiment. The *experimentum crucis* was what they really wanted; wires of different conducting powers tested against each other, and the results ascertained by the best class of instruments, and, he would add, by a variety of experimenters. He found that electricians still remained true to their colours, in the absence of positive results one way or the other. His friend, Mr. Walker, still adhered to the small wire, whilst others appeared as the consistent advocates of a large wire as the best conducting medium. In this country, such opportunities were presented for experiment upon a large scale, that they had nothing to fear from theory; and he hoped such experiments would be made as would solve many of the points upon which so much diversity of opinion now prevailed.

THE PORTRUSH ELECTRICAL TRAMWAY.

IN the ELECTRICAL REVIEW for April 28th, and Sept. 1st, 1883, will be found described, at great length and completely illustrated, an account of this tramway recently constructed in Ireland. When our journal meets the reader's eyes, the ceremony of publicly opening the line will have taken place in the presence of the Lord-Lieutenant, Earl Spencer, and his Countess. The procession was arranged to leave Portrush at 12·15 p.m. on the 28th inst., and it

was expected that the following distinguished persons would be the guests of Dr. Traill, the Chairman of the Tramway Company :—Sir William and Lady Siemens and Miss Gordon, Sir William and Lady Thomson, Sir Frederick Bramwell, the Provost of Trinity College and Mrs. Jellet, the Astronomer-Royal of Ireland, Mr. Williamson, F.T.C.D., Dr. Shaw, F.T.C.D., Rev. T. Gray, F.T.C.D., Dr. Tarleton, F.T.C.D., Professor Fitzgerald, F.T.C.D., Professor Crawford, T.C.D., Dr. Robert M'Donnel, Colonel George Traill, R.A., and Mr. Alex. Richardson.

Although our readers have only to refer to the numbers of the ELECTRICAL REVIEW mentioned above for all the technical details of the Portrush Electrical Tramway, we are sure that the following additional information will be most acceptable :—

A concession was granted in 1878 by the Grand Jury of the County Antrim and by a Privy Council Order to the promoters of the Ulster Steam Tramway Company, for making a tramway from Portrush to Bushmills, to be worked by steam. That company was unable to raise the capital, and finally became insolvent. An Act of Parliament was obtained by Dr. Traill, F.T.C.D., and his brother, Mr. William A. Traill, in 1880, to make this tramway, and also a narrow gauge railway from Bushmills to Dervock, two years having been allowed for the completion of the former and five years for the completion of the latter. The tramway has been completed and opened for traffic by steam since January last, but great delay has been experienced in getting together all the requirements necessary for working the line by electricity. The Messrs. Traill, foreseeing that there was possibly a great future for electricity as a motive power, especially if generated by water power, obtained authority in their Act to use it, or any other kind of mechanical power. They entered into arrangements with the eminent firm of electrical engineers, Messrs. Siemens Bros., of London and Berlin, and secured advantageous terms from them for the introduction of electricity as a motive power upon a large scale, and suitable to heavy goods or passenger traffic. While making sure of their traffic on the line and developing it, by means of two of Wilkinson's steam tramway engines, they have for more than a year been conducting an elaborate series of experiments, under the personal superintendence of Dr. Edward Hopkinson. The attempt to convey the electric current along the line was first tried by means of the ordinary rails, which were insulated in asphalte and copper-fastened to each other. This was found to give fair results for nearly two miles, but beyond that distance the leakage was too great to justify the experiment for a greater length. It then became necessary to insulate more completely. This has been done by fixing a third rail close to the fence, raised about 15 inches above the ground, and insulated by means of caps of insulite on wooden posts. The inspector of the Board of Trade has examined minutely into the question of the E.M.F. of the electric current, and he has certified that so long as the E.M.F. does not exceed 250 volts, it is perfectly safe. Particular provision is made that under no circumstances can it rise above this point, and this is not left to the will or power of any engine-driver or other machinist, but is secured by self-acting governors attached to the apparatus which drives the generators.

The experiments above referred to have been made with a current generated by a dynamo, worked by a small stationery engine at Portrush of about 15 H.P. Once the result of these experiments showed that success was certain, the Messrs. Traill set about obtaining the water power upon the River Bush at the salmon leap. A long delay occurred in this matter, owing to the fact that the tenant of the farm to which the water power was attached was in litigation with the landlord, in the Land Courts, both as to the rent of his farm and also with respect to this water power, the mill attached to it having been burned down by accident. The case was only finally settled in the Appeal Court last March, when the Head Land Commissioners made such an order as enabled the landlord to give the Messrs. Traill the complete frontage of the river, with the absolute control of the water power—in fact, everything that was necessary to carry out their project. Two powerful turbines from Allcott, of New York, have now been erected, and they will produce a total of 90 H.P. at a very small cost. The works connected with the erection of these turbines have been planned and executed by Mr. William A. Traill, the engineer of the company. This entailed some heavy work, to blow up and remove the ruin of the old mill and stores, to deepen and widen the lead bringing down the water from above the falls, to cut a new channel for a considerable distance through solid rock, and finally to erect the turbines, and the machinery to be worked by them, on the face of a cliff thirty feet high. All has, however, been successfully accomplished, and a new dynamo house erected, in which the electrical apparatus is kept ; a new avenue along the top of the cliff has been made, and altogether the whole aspect of the place has been entirely changed and much beautified. An insulated cable laid beneath the surface of the road conveys the current to the conducting rail about three-fourths of a mile distant, and thence along the rail to Portrush, supplying the moving cars at any point on their journey. The distance is six miles, and the inclines and curves on the road are very severe, the former often reaching one in forty, or one in thirty-five, and for a short distance even one in thirty. In the progress of these experiments many hitches have occurred and many apparent failures, but all these difficulties and obstructions have been by degrees overcome, and everything now works so smoothly and so easily that the cars appear to the uninitiated to move by magic.

It has required no small amount of enterprise and pretty strong determination of will to undertake an experiment of so large a nature, and to beat down the opposition which ignorance and prejudice always create against a scientific novelty of the kind, and it is no small honour to the north of Ireland, and to the two gentlemen principally concerned, that the first great experiment of the kind in the United Kingdom has been made in that portion of her Majesty's dominion at a time when the rest of Ireland was in a state approaching to anarchy, and when, had Ulster listened to the agitators, and joined in the cry for separation, it would have been impossible for England to have kept the union intact without a reconquest of Ireland. There still remains an opportunity for some large-hearted English capitalist, or man of science, to push this electrical experiment to a further point. The Messrs. Traill have power under their Act to make a railway seven miles long from Bushmills to Dervock, which will connect their tramway with the narrow gauge railway from Ballymoney to Ballycastle, and so open a new and wealthy district. As the waterfall on the Bush river is at the junction of this railway with the tramway, and as the line of the proposed railway is on a level for the whole distance, it can be as cheaply made, and more cheaply worked, than the tramway, and by the electric current. The financial results of the tramway have already far exceeded the anticipations of the public, and they have proved that rapid and cheap transit in a thickly populated country will soon produce travellers and develop traffic in goods and minerals, where such exist, such as never could otherwise have been calculated upon. Baron de Rothschild has recently given £40,000, it is said, to Marcel Deprez to make an electrical railway in France and to carry out his scientific experiments on electricity as a motive power, and this magnificent gift is made without any restrictions, or without any question as to such railway, when made, being a financial success ; but here in the north of Ireland, in a prosperous and loyal district, with a large traffic in goods and minerals already established, and with the unrivalled scenery of the Giant's Causeway at the termination of the line, any English capitalist, or liberal supporter of science, might safely send financial assistance across the water to complete an experiment unique of its kind and so far attended with wonderful success.

NOTES.

To Our Readers.—In our last issue, we stated that it was to be feared that the widow and family of the late R. Werdermann had, by his decease, been left totally unprovided for. This forecast has unfortunately proved but too correct, and we have been appealed to, to request the aid of those of our readers who have the means, and are disposed, to assist this family, which, by no fault of its own, is for the present brought face to face with an utter want of the bare necessaries of existence. From those who personally knew Mr. Werdermann, we have reason to hope that our appeal will meet with a prompt response. We would, however, ask those who were not intimately acquainted with him to help us to assist those who, by the untimely death of their natural supporter, are left in a position as novel to them as it is painful; for with such aid they may be given that necessary time for developing their resources, and to adapt themselves to their very altered circumstances. Some such similar grief and loss might overtake any amongst the electrical brotherhood; shall, therefore, our appeal, for the bereaved ones of this lamented, earnest worker, be made in vain? Cheques and post-office orders (on chief office) may be made payable to H. Alabaster, Gatehouse & Co., and addressed (Werdermann Fund), ELECTRICAL REVIEW Office, 22, Paternoster Row, London.

Electric Lighting.—Some of the streets in Stockholm are now being lighted very successfully. The installation consists of 12 Pilsen lamps, fed from a Schuckert 12 light dynamo machine, driven by a 10 H. P. (nominal) portable engine of Swedish make. Great satisfaction is expressed at the lights, and one of the newspapers there says: "We have noticed that the working both of the machinery and of the lamps has been more even and with better effect than the systems of electric lighting formerly tried at Stockholm (Brush, Siemens, Jurgunsen, Jablochkoff).

The electric light fittings at the New Lyceum Theatre, Edinburgh, which was opened by Mr. Irving on Monday, 10th inst., were designed and manufactured by Messrs. Faraday and Son, of 3, Berners Street, W. The same firm has recently supplied a quantity of this class of fittings for a new theatre in Amsterdam.

On the 17th inst. the Pilsen-Joel Company was requested to light up the Western and Foreign wing of the Fisheries Exhibition, and on the evening of Wednesday, the 19th inst., fourteen Pilsen arc lamps of 2,000 C.P. were in successful operation, fourteen other lamps of the same kind being added on the 20th inst. Considering that this installation involved the running of nearly a mile of leads, besides the fixing of dynamo machines and other apparatus, the Pilsen-Joel Company certainly gave proof of an ability to carry out electric lighting work with promptitude and efficiency.

At Tuesday's meeting of the City Commissioners of Sewers, Mr. George Shaw presiding, a report was brought up from the Electric Lighting Committee by Mr. E. J. Stoneham on the reference empowering them to prepare a draft licence, framed on the principle of the Commissioners' undertaking the supply of electricity in the City, and to contract with reliable companies for that supply. They advertised, inviting proposals for areas not exceeding in each one-eighth of the entire district, and they received replies from the Gülcher, Hammond, Jablochkoff, Maxim-Weston, Metropolitan Brush, and Pilsen-Joel Companies. The nature of those replies made it evident that both in negotiating a contract with the companies to be embodied in a licence, and in opposing the applications for a Provisional Order before the Board of Trade, it would be necessary to obtain the advice and assistance of skilled electricians, and they had therefore retained the services of Mr. W. H. Preece, F.R.S., of the General Post Office, and Mr. Heaphy, of the Phœnix Fire Office. The proposals of the companies being considered vague and unsatisfactory, the Committee requested Mr. Preece to prepare a specification for lighting an area of the City by electricity, in accordance with the provisions of the Electric Lighting Act and the regulations of the Board of Trade. In the meantime certain of the companies modified their proposals, and it was decided that the Maxim-Weston, Gülcher, Pilsen-Joel, Metropolitan Brush, and the Telegraph Construction and Maintenance Companies should have an opportunity of tendering in accordance with the specification. The committee now requested authority to make certain experiments, at a cost of £200, with a view to determine the best distribution of incandescent lamps of the proper intensity of light, so that the companies tendering might have before them definite figures to guide them in fixing their prices. Mr. Stoneham moved the adoption of the report. Mr. Innes, in adversely criticising the action of the committee, thought it would be impossible for electric lighting companies to light the streets at a profit unless they made a charge which the ratepayers would not be inclined to bear. The sum paid to the gas companies for street lighting was exceedingly small, but the companies made their profits by supplying private houses and warehouses along the route. If any arrangement were made with the electric lighting companies they should be allowed to make their own bargains with private owners, and if that were done the streets would soon be lighted by electricity. He doubted the wisdom of the proposed experiment. After some further discussion the report was adopted, and Mr. Innes gave notice that it was inexpedient to continue the Electric Lighting Committee, and that the reference be transferred to the Streets Committee.

The galleries of the Dundee Fine Art Exhibition, shortly to be opened, are again to be electrically lighted, and on a more extended scale than last year.

The Town Council of Birkenhead, at its last meeting, sanctioned an application made by the Manchester and District Edison Electric Light Company for permission to fit up one of the ferry steamers with the electric light, free of cost to the Corporation, as an experiment. The dynamo machine is of the Edison-Hopkinson type, driven by a three-horse power (indicated) engine, constructed by Messrs. Mather and Platt, Manchester. These are placed in the engine-room of the vessel. Twenty-six lamps have been fitted up, sixteen of which are in the deck saloons, and the remainder in the fore and aft cabins and the engine-room. The saloons and cabins were most brilliantly lighted, and the universal verdict of the large number of persons who crossed the river after the lamps were lit was that the electric light is admirably suited for such a purpose.

The electric light occupied a very prominent place among the illuminants at the Duthie demonstration, held in Aberdeen on Thursday.

The Board of Trade and Electric Lighting.—At a meeting of the Lambeth vestry last Thursday week, the following letter was read from the Board of Trade, in reply to an application to supply electricity under the Electric Lighting Act:—"The Board of Trade have had under consideration the applications for licences which have been made to them under the Electric Lighting Act. Some of these applications are made by electric lighting companies, and extend over large areas, involving a large expenditure of time and money. According to the terms of the Electric Lighting Act such licences can only be granted for seven years, and at the end of that time the undertakers and all the capital they may have expended are subject to the re-decision of the local authority and the Board of Trade as to whether the licence should be renewed, and if so, on what terms and conditions. It must be some time from the date of the licence, probably two or three years, before such an undertaking can be brought into full operation, and there would then remain not more

than four or five years during which the undertakers could expect to reap the fruits of their enterprise. During this period, moreover, they would be exposed to severe competition with gas. It is difficult to believe that under such circumstances prudent and capable investors will be found able and willing to provide the capital necessary for so large and so hazardous an undertaking, and that which is unsafe and imprudent for investors can seldom be for the ultimate good of the public. But this is not all. The grant of a licence when approved by a local authority, and adopted by the Board of Trade, is final and there is not, as in the case of a Provisional Order, any means of preventing or modifying it by an appeal to Parliament. If, therefore, as has lately been the case in more than one instance, consumers should be dissatisfied with the action of the local authority and of the Board of Trade, they will, in the case of a licence, have no remedy. Under these circumstances the Board of Trade have come to the conclusion that they will grant no licences to Electric Lighting Companies for wide areas, such as the whole of a provincial town or of a London parish. This does not apply to smaller areas, containing, for instance, a limited number of streets, squares, or public buildings, which a company may well be willing to light by way of experiment or otherwise. Nor does it apply to cases in which local authorities themselves are the applicants for the licence. I am to add that the Board of Trade, whilst adopting the above conclusion, and making it known for the convenience of applicants, do not propose to proceed with any of the licences now before them until October.—I am, &c., HENRY G. CALCRAFT.

Electric Light Companies.—The *Daily News* expresses the general desire of the public to know what the electric lighting companies are doing. Some of them, it asserts, "are being wound up; there has been a great fall in the value of the shares of some others; and disappointed investors may be pardoned for suspecting that the promises held out were mere illusions, or worse. But the anticipations of a revolution in domestic lighting were sober enough, and it will be fully justified in the long run; it is the eagerness of the public to make money out of it which has checked its progress and caused all the loss. Every petty inventor saw the opportunity of selling his patent to companies eager to buy; and as a result valueless 'concessions' were sold for large sums, and even valuable inventions were bought at extravagant and unremunerative prices. On its commercial side electric lighting has passed through a crisis. A speculative mania has been succeeded by a panic; but there is now reason to hope that the panic will be followed by a steady attention to business, and a gradual but probably not rapid development of the public uses and capabilities of electricity."

Electric Light Companies Shares.—At the Stock and Share Auction and Advance Company's sale last week the prices obtained for London and Provincial and Jablochkoff shares were 10s. and 27s. 6d. respectively.

Electricity and the Mayoralty.—It is said that an organised opposition has been arranged in the City to oppose the proposed nomination to-day of Mr. Alderman Hadley as the Lord Mayor elect. Various reasons have been given to account for such a proceeding against this gentleman, who is well known in connection with the proposed new Atlantic cables. It seems to us that the true reason, although we have not seen it mentioned elsewhere, is to be found in this very matter, or in other words, it appears more than probable that the cables which should be at the bottom of the Atlantic are at the bottom of the opposition, which it is to be hoped will not prove successful.

Vienna Electrical Exhibition.—On Tuesday last the electrical launch, which forms the most novel and attractive feature of the Electrical Exhibition at Vienna, and which has already been mentioned in our columns, conveyed a distinguished party on the longest trip yet made in such a vessel. The launch started from Vienna and followed the course of the Danube to Pressburg, a distance of about fifty miles, accomplishing the journey in four hours, or about twelve and a half miles an hour, with the stream. This launch, as our readers are aware, is the joint production of the Electrical Power Storage Company, Messrs. Siemens Brothers & Co., Limited, and Messrs. Yarrow & Co.

The Ferranti Dynamo Machine.—C^2 R. in a letter in *Engineering* of the 31st ult., points out that in that journal of March 30, Messrs. Ferranti, Thompson and Ince promised to have the engine then driving the Ferranti machine at the Westminster Aquarium Exhibition indicated, with a view to the publication of the results. These results have not yet appeared, and the writer expresses a hope that Messrs. Ferranti, Thomson and Ince will no longer withhold particulars of the working conditions of their machine, particulars which, as regards every other prominent dynamo, are already in the hands of the public. Messrs. Ferranti, Thompson and Ince in reply, explain that they were, to their great regret, compelled to forego their intention of publishing the results of an indication of their machine at the Aquarium, as this indication could not be made, and to show that their failure in fulfilling their promise was not the result of any fault of their own, they publish an extract from a letter they received from Messrs. Davey, Paxman & Co., in which the latter state that the former requested them to indicate the engines and give them the consumption of power indicated by their dynamo. They had commenced to fix the indicator gear to the engine, when their man met with an accident by jamming his hand, and had to return without getting the desired result, The consequence was that they were so busy just at the close of the Aquarium Exhibition with work for the Fisheries Exhibition that they could not attend to it, although they tried their best. Messrs. Ferranti, Thompson and Ince intend shortly to publish a full report of some tests they are now engaged on, so that the public may no longer have reason to complain that they are claiming merits for their machine that it does not in reality possess.

Cable Repairs.—The Eastern Telegraph Company notifies the repair of the Amoy-Shanghai cable, thus restoring telegraphic communication *viâ* India with Shanghai and all other places in China.

Cable interrupted.—The Brazilian Submarine Telegraph Company notifies the interruption of the St. Vincent, Pernambuco cable.

Will Atlantic Traffic Support two New Cables?—We have received a letter, in response to our article on this subject, from Mr. H. Weaver, managing director of the Anglo-American Telegraph Company. It unfortunately reached us too late for insertion in this, our present issue, and it will, therefore, appear in our next.

Proposed New Method of Laying Telegraph Wires.—Mr. Peter Stuart (of Stuart & Co., Edinburgh) has devised a new method, says the *Scotsman*, of laying telegraph wires, which, one would fancy, only requires to stand the test of practical working to be recognised as a desirable improvement upon existing arrangements. What Mr. Stuart proposes is a comparatively inexpensive method of carrying the wires underground, which, if found applicable in towns, might in course of time be also adopted for the great cross-country lines, so as to obviate the constantly recurring interruption of telegraphic communication by gales and snowstorms. As set forth in the specification of the patent, the system could be carried out in different forms. The simplest would be the laying, say, under the kerbstone, or under any part of the pavement or carriage way, as might be

found most convenient, of a continuous line of concrete or granolithic slabs, with deep longitudinal grooves moulded into their upper surface. In these grooves it is proposed that the wires should be laid, embedded in some insulating material, which should fill the hollow. Or if, as seems probable, the embedding of the wires should be objected to, they could be laid loose in the grooves. An alternative plan would be to form the kerbstones—as might be safely done with a material of the strength of granolithic—in two concave halves, which, when jointed together, should leave a considerable internal space. In this miniature tunnel the wires might be carried on props, made of some insulating substance, or otherwise disposed as should be deemed most expedient. There is also set forth a variation of this arrangement, where the tunnel, necessarily of much smaller dimensions, would be formed in the interior of a thick granolithic paving slab, moulded like the hollow kerb stone, in an upper and a lower half. Whichever form were adopted, openings would be left at suitable intervals to give access to the wires, for purposes of overhaul or repair. We understand that Mr. Stuart proposes to take steps with the view of having his invention tried in Edinburgh streets.

Telegraphic.—At a recent meeting of the Cleckheaton Local Board, a letter was read from the Postmaster-General relative to telegraphic extensions throughout the district, and asking the Board to assist in carrying out the necessary works in connection with the proposed extension. The letter stated that in view of the reduced charges for telegrams, a considerable increase will immediately thereafter take place in the number of telegrams. Consent was given to the erection of poles and wires in the Board's district, as desired. The letter also stated that it would be necessary to erect at once a considerable number of additional lines in other parts of the country.

The Aberdeen Chamber of Commerce learns that a new wire is to be erected between Inverness and Aberdeen, another between London and Aberdeen, and a new cable laid to the North Isles. The telegraph staff at Aberdeen is to be increased.

Telephony and Telegraphy.—Mr. C. Langdon-Davies, of 110, Cannon Street, sends us the following information:—The Van Rysselberghe telephone has been working for about a year on one of the ordinary telegraph wires, running in company with many other telegraph wires, from Brussels to Ostend (120 kilometres). The telephone works perfectly; the telegraph works on the same wire and on the neighbouring wires, precisely as usual—telephone and telegraph thus working together, without either receiving any inconvenience from the other. In May, 1883, a regular telephonic service was commenced between the House of Parliament at Brussels and the printing office of *La Flandre Libérale*, at Ghent, on one of the ordinary telegraph wires. The telegraph wire is incessantly at work, conveying telegraphic messages, and simultaneously it conveys, by means of the Van Rysselberghe telephone system, the reports of the Parliamentary debates, dictated in the Chamber at Brussels and heard in the printing office at Ghent. Not only so, but the *Daily Exchange* reports from the Bourse, including hundreds of quotations in figures, are transmitted correctly, by word of mouth, over this telegraphic wire. This has continued daily with perfect success. Numerous official trials have been made by officers of administrations of various countries, with unvarying success. In August of this year, after receiving the most ample evidence of the great public utility of the invention, the Minister of Public Works in Belgium established, at the expense of his Government, an experimental service between Brussels and Antwerp, and upon the results obtained, has decided to adopt the system for the service of the whole country. This experimental service was placed for a week at the disposal of the subscribers to the Bell Telephone Exchanges of Brussels and Antwerp, who availed themselves of it to the fullest extent; and in this way thousands of independent experiments were tried with complete success. The members used the ordinary instruments, which they had been employing in their short circuit of two or three miles, and found them work just as well, on the Van Rysselberghe system, over the long distance. The results would have been superior, and conversation would have been held with still greater facility over the long distance than over the short, if the new instruments, now available, had been employed. The Press of the country has been unanimous in describing—in terms of enthusiasm—the important results obtained. The Government of Holland, after a searching investigation, has made a contract with Mr. Langdon-Davies, the proprietor of the system, for a definite installation upon the telegraph wires between Amsterdam and Haarlem, in contemplation of the subsequent installation of the entire telegraphic *réseau* of the country. This service, which will be upon a practical and permanent scale—not a mere experiment—is expected to be in action about the 15th October, when the public will have an opportunity of practically testing the system, and the Dutch Administration will give especial facilities for investigation to scientific men and others especially interested.

Telephonic.—It is rumoured, but we know not if it be true, that the United Telephone Company has obtained an injunction against a certain opponent, restraining it for the present from using the "Mechanic" receiver.

Telegraphic communication with Brazil.—A *Times* telegram, dated Philadelphia, September 21st, says, the Central and South American Telegraph Company have finished their line to Brazil, *viâ* Galveston, Texas. It was opened for business to-day (Friday). President Arthur has sent to the Emperor of Brazil the following congratulatory telegram:—"The President and Government of the United States salute the Emperor and people of Brazil through the new channel of direct communication between the two countries this day opened *viâ* Galveston and Valparaiso, and they see in these multiplied links of intercourse an assurance that happy relations between them will continue and increase, to the material benefit of both countries." The New York Chamber of Commerce, with other similar bodies, have also sent congratulatory telegrams.

Telephonic communication.—On Saturday week last the workmen who have been putting up the wire between Arynagour and Brekach finished their labour, and for the five miles between these two places communication was established. To annihilate the space of five miles, as has been done in Coll, is, no doubt, profitable, even commercially speaking, and there is all the comfort and convenience over and above. Mr. W. C. Muir, of 140, Douglas Street, Glasgow, was the contractor.

Opera by Telephone.—An experiment was made the other evening in Manchester at the house of a gentleman resident in Victoria Park, who, by arrangement with the management of the Prince's Theatre and with Mr. Carl Rosa, was permitted to place telephonic transmitters on the stage, and to afford his invited guests, two miles away, the opportunity of following the opera of "The Bohemian Girl" at pleasure. We note, as a somewhat curious circumstance, that in a vocal quartett the voices of Miss Perry and Mr. Ludwig, soprano and bass, were transmitted more audibly than those of Mr. Davies and Miss Burton, tenor and contralto. So far, however, as the latter lady is concerned, we should on all occasions prefer her magnificent voice, minus the telephone. Again, although nothing can be more different than the tone qualities of a cornet and clarionet, yet it is stated that through the telephone they have a *timbre* so similar as to be almost indistinguishable. We should like to know whether the listeners were thoroughly acquainted with the characteristics of vocal and instrumental music, as totally different effects would probably have been conveyed to the musical and to the non-musical ear.

The Van Rysselburghe System of Simultaneous Telephony and Telegraphy.—Herz *v.* Van Rysselberghe.—This case, which has been before the Courts in Brussels for about a year, is now, we are informed, finally decided. It arose out of a negotiation for the purchase of some of M. Van Rysselberghe's earlier telephonic patents, which fell through. After M. Van Rysselberghe had signed the contract for the sale of the whole of his patents to Mr. Langdon-Davies, Dr. Herz asserted that he had a prior right to purchase the patents, and brought this action against Van Rysselberghe for specific performance, and also for four millions of francs damages. The Court of Premier Instance gave judgment against Herz, and condemned him to pay the costs. The Court of Appeal also gave judgment against Herz, and condemned him to pay all costs, and also compensation for all damages resulting from the litigation. The effect of this decision is to establish Mr. Langdon-Davies' position as owner of all the patents throughout the world. *Fiat Justitia.*

Ben Nevis Observatory.—Arrangements have been completed with the Post Office for erecting a line of telegraph between Fort William and the summit of Ben Nevis. The Council of the Meteorological Society, we learn, declared themselves in favour of establishing a regular post office telegraph station at the observatory, with one of the observers to act as clerk. The Lords of the Treasury, however, did not see their way to accept the proposal, but offered a private wire at an annual rental of £167 for a term of seven years. This offer the Council of the Meteorological Society has accepted, with the understanding that the officers of the observatory shall be permitted to accept public telegrams, and that a commission shall be paid to the Society in respect of this service.

The Silvertown Institute.—The prizes and certificates awarded by the Science and Art Department to the students of the above institute will be presented by Matthew Gray, Esq., in St. Mary's School-room, Silvertown, on Monday, October 8th, at 7 30 p.m. The committee of the institute desires to secure the attendance of those who are interested in the advancement of education.

University College, Dundee.—In this college electrical engineering will be taught during the winter session in a special course of lectures and laboratory work. From the prospectus before us, the course appears to be very complete, and every facility is offered for practical as well as theoretical acquaintance with the subject.

College of Science and Arts, Glasgow.—This technical institute, so ably presided over by Principal Andrew Jamieson, needs no recommendation from us. Its former successes have figured in our columns, and in the past session the students attending the classes have secured many distinctions. Mr. John Pender, M.P., has offered a gold medal to be competed for by electrical engineering pupils during the session commencing on October 1st.

Electricity v. Gas.—The *Philadelphia Ledger* says:—The illuminating folks have grown very quarrelsome, and at present there is a triangular fight going on with the water gas, the coal gas, and the electric light advocates as mutual antagonists. It is amusing to read in the gas journals the horrible tales of accidents, and of destruction to health, eyesight and complexion resulting from the use of either the rival gas or the electric system of lighting. The prices, too, seem to bother them very much. The complaints made against Edison by the gas makers is—first, that his light costs too much, and second, that he charges too little for it. But if this complaint is true, they ought to possess their souls in patience, for he cannot be expected to stand it very long. The coal gas representatives having been beaten by water gas in cost, attack it as extremely dangerous, and the cause of most of the accidents of suffocation. This is "important if true," but it must be confessed that the water gas advocates have just as pretty tables of figures the other way, and between them all these lighting companies manage to leave us as much in the dark as ever. There is room for all of them, however, if they will be content with moderate profits. It is the charging of too high prices which attracts rivals into the field.

Winding-up Notice.—Intimation to the shareholders of the Brush Electric Light and Power Company of Scotland, Limited, has been made that it is desirable to voluntarily wind up the company. The liquidation of the company implies that the Provisional Orders obtained in the last session of Parliament will fall to the ground, unless they can be taken up by other companies. The report of the directors will be found in our "City Notes" columns.

Emmerson, Murgatroyd & Co., Limited.—A petition for the winding up of this company, presented on Sept. 18th, by W. H. Beck, of 115, Cannon Street, consulting engineer, will be heard before Mr. Justice Pearson, October 3rd.

OFFICIAL RETURNS OF ELECTRIC COMPANIES.

Electrolysis Company, Limited.—An agreement, dated 11th inst., has been entered into by this company for the purchase from Charles Augustus Gregory, of Chicago, now staying at 5, Duchess Street, Portland Place, of the French and Belgian patents granted in respect of an invention of a new and improved process and apparatus for separating compounds of metals by electrolysis. Application has been made for a British patent, which, when granted, will be assigned to the company. The purchase consideration is £40,500, payable £850 in cash and £39,650 in fully-paid shares. Registered office: 51, Queen Victoria Street. Richard Guy, secretary.

British Electric Light Company, Limited.—The annual return of this company, made up to the 18th inst., was filed on the 19th inst. The nominal capital is £100,000, in £10 shares. 7,241 shares have been taken up, and the full amount has been called and paid up thereon. Registered office: Turk's Head Yard, Turnmill Street, Clerkenwell.

Great Western Electric Light and Power Company, Limited.—The annual return of this company, made up to the 17th inst., was filed on the 22nd inst. The nominal capital is £250,000, in £5 shares. The number of shares taken up is 24,044, of which 3,000 were issued to the vendors as fully-paid. A call of £2 10s. has been made on the 21,044 ordinary shares, the calls paid thereon amounting to £5,500. The sum of £2,390 has been paid on 956 shares returned. Registered office: 31, Lombard Street.

Gülcher Electric Light and Power Company, Limited.—The annual return of this company, made up to the 12th inst., was filed on the 19th inst. The nominal capital is £300,000, in £5 shares. The number of shares taken up is 47,747, of which 19,660 are considered as paid up. The sum of £2 10s. has been called upon the remaining 28,087 shares, the calls paid amounting to £62,206 1s. 8d., leaving £8,011 8s. 4d. unpaid. The sum of £100 has all been paid upon 250 shares foreited. Registered office: Battersea Foundry, Battersea.

Telephone Company of Austria, Limited.—The first return of this company, made up to the 14th inst., was filed on the 18th inst. The nominal capital is £100,000, in £5 shares. The number of shares allotted is 6,007, 6,000 of which are considered as fully-paid. Upon the remaining seven no call has as yet been made. Registered office: 34, Walbrook.

French Metropolitan General Electric Company, Limited.—Special resolution passed at meetings of this company, held on 22nd ult. and 6th inst., were filed on the 21st. By such resolutions the nominal capital of

the company is altered from £1,200,000, in shares of £20 each, to £1,200,000 in £10 shares. Each of the existing £20 shares which have been fully paid up will be divided into two fully-paid £10 shares, and each existing share of £20 upon which £1 has been paid will be divided into two £10 shares credited with 10s. as paid up.

Electric Carbon Storage and Apparatus Manufacturing Company of Scotland, Limited.—An order of the High Court of Justice, Chancery Division, dated 15th ult., was filed on the 20th inst., ordering the winding-up of the company, upon the petition of Edward Mather, of Alexander Mather & Son, of 121, Fountain Bridge, Edinburgh, engineers, and the appointment of John Evans Jackson, the secretary of the company, to be provisional liquidator, with powers limited and restricted to the carrying on of the business of the company, with a view to its sale as a going concern.

NEW COMPANIES REGISTERED.

Electro-Amalgamator Company, Limited.—Capital £200,000, in £5 shares. This is a re-construction, with an increased capital, of the Electro-Amalgamator Company, now in course of voluntary winding-up. Signatories (with one share each) :—R. S. Gladstone, Tower Chambers, Moorgate Street; C. F. Jarm, 145, Wilberforce Road, S.E.; N. Tronson, Bromley, Kent; T. R. Hewitt,114, High Street Kensington; H. W. Smith, 58, Coleman Street; W. A. Hornbuckle, 19 and 20, Water Lane, E.C.; A. J. Snelgrove, 6, Lady Somerset Road, N.W. Registered 21st inst., by Miller, Smith & Bell, of 3, Salters' Hall Court. Registered office, Tower Chambers, Moorgate Street.

Electric Company, Limited.—Objects :—The carrying on of the business of electrical and general engineers, contractors, manufacturers, dealers, agents, and patentees. In lieu of specified nominal capital, every member undertakes to contribute to the assets in the event of the company winding-up any sum not exceeding £1 that may be required. Signatories :—Capt. P. M. Syme, R.A., Ashford; G. C. Vincent Holmes and Mrs. Holmes, 13, Sussex Villas, Kensington; F. E. Burke, C.E., Members' Mansions, S.W.; F. Cheesemique, Sutton; E. J. A. Holmes, Ashford; and Stephen H. Emmens (electrical engineer), 8, Argyll Street. A managing committee of three members will direct the affairs of the company, Registered 21st inst., by E. B. Illidge, 8, Argyll Street.

CITY NOTES, REPORTS, MEETINGS, &c.

The Direct Spanish Telegraph Company, Limited.

THE Twentieth Ordinary General Meeting of this company, a full report of the proceeding of which will be given in our next issue, was held at the offices of the company, Leadenhall Buildings, Leadenhall Street, yesterday, at which the following report of the directors was submitted :—

The accounts for the half-year ended 30th June, 1883, show a balance to the credit of profit and loss of £6,642 17s. 1d. The receipts may be considered satisfactory in view of the fact that the Bilbao cable was interrupted from the 14th January to the 23rd February, and again from the 9th March to the 2nd April. The directors were authorised by the shareholders at an extraordinary general meeting, held on the 27th July last, to lay a duplicate cable between England and Spain, and the carrying out of this authority will have their best consideration when the proper time comes. The interruption of the Bilbao cable, which took place on 6th August, was promptly repaired and the cable reopened to traffic on the 27th August. It has since continued in good working order. The Marseilles-Barcelona cable remained in perfect working order throughout the half-year and continues so. The opening of the special wire between London and Falmouth, by means of which direct communication with Spain is maintained from the Company's office in Leadenhall Street, took place on the 1st January last. This arrangement has proved successful, and the directors believe that a further development of the traffic will result from it. After paying the dividend on the preference shares, £3,000, and putting aside £200 to the reduction of preliminary expenses account, there remains a balance of £3,442 17s. 1d., which, looking to the repairs of the interruption of 6th August, it is proposed to carry to the reserve fund, that fund having been reduced to £820 18s. 11d., after providing for the repairs of the Bilbao cable in January, February and March last. The dividend warrants on the preference shares will be issued as soon as remittances from Spain for the balance of the telegraph accounts to 30th June last are received.

The Brush Electric Light and Power Company of Scotland, Limited.

THE second ordinary general meeting of the shareholders was held at Dashwood House, New Broad Street, yesterday. The report of the directors for the period commencing with the allotment of the company on the 3rd May, 1882, to 31st July last says :—"The attention of the directors has unceasingly been given to pressing forward the general business of the company, whether by concessions or sale of plant, or by endeavouring to secure Provisional Orders under the Board of Trade rules for lighting various towns in Scotland. Notwithstanding that the action of the legislature imposed such serious conditions and took away many rights the directors thought they possessed when the company was formed, every exertion has been made by your Board to sell machinery at a profit, or even to cover cost, but they have been comparatively unsuccessful, although the company at considerable expense exhibited experimental lighting in every variety at Edinburgh, Aberdeen, and Dundee, to demonstrate its usefulness and applicability. At Glasgow, our offer to erect trial lamps for the price of gas met with a refusal, and in our application for Provisional Orders, before the Board of Trade, for Glasgow, Edinburgh, Aberdeen, and Dundee, our overtures were met by such strenuous resistance from the local authorities, supported somewhat by the Board of Trade, that we were compelled to abandon the attempt, except in the case of Dundee, for which town a Provisional Order, reduced to 15 years, has been issued in our favour, but which, in its final form, has been so beset by provisos that it is doubtful whether it could be profitably worked, at least until the demand for electric lighting becomes more general than seems probable at present. The people of Scotland, as represented by their town authorities, are, at present, adverse to the introduction of the electric light, or only wish it for trial on terms that will not pay this company, while the competition of 24 candle-power gas in Scotland is also serious, especially where the inhabitants require heat as well as light in their rooms, and treat with indifference all arguments as to vitiated air, destruction to silver plate, pictures and ornaments, and finally, there is the difficulty and expense of working a concern like this with practically no support from Scotland. Owing to representations made to them, the Board were desirous of equalising the two different classes of shareholders, and were advised as to the proposals laid before the last meeting, but afterwards finding that legal doubts existed, and that expensive litigation would probably ensue, they desisted, and for the reasons given above, now recommend the voluntary winding-up of the company upon an equitable basis. Anticipating that the shareholders will agree to a voluntary liquidation, and on this point the Board are led to believe that there is a very strong feeling, they have called an extraordinary meeting to follow on the ordinary meeting, at which a special resolution to the above effect will be proposed. There are assets other than cash in regard to which the directors have made a conditional arrangement for the disposal of the most important portion, which will considerably improve the division, and they can further state that the great majority of the fully-paid shareholders have signified their assent to an equitable arrangement in the voluntary winding-up."

The Gülcher Electric Light and Power Company, Limited.—Another meeting of this company was held at the Cannon Street Hotel, on Tuesday. Reporters were again excluded.

The West Coast of America Telegraph Company, Limited.—Telegraphic communication with Valparaiso, Mollendo, Arica, Iquique, Antofagasta, Santiago de Chili, Buenos Ayres, Montevideo, and all telegraph stations in Peru, Chili, the Argentine Republic and Uruguay, is now re-established *vid* Galveston.

The Electro-Amalgamator Company, Limited.—This company is to be wound up voluntarily, with the view of the transfer of the property to a new company.

The Exchange Telegraph Company, Limited.—This company has issued revised tariff rates for the supply of commercial, general home and foreign news, parliamentary reports and summaries, racing telegrams, &c., to newspapers, clubs, exchanges, news-rooms, &c.

TRAFFIC RECEIPTS.

The Brazilian Submarine Telegraph Company. The receipts for the week ended the 14th inst. amounted to £2,914.

The Brazilian Telegraph Company, Limited. The receipts for the week ended the 7th inst. amounted to £2,666.

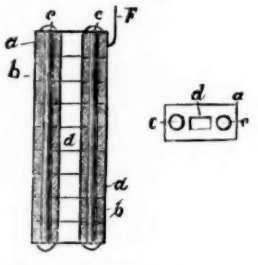
The West India and Panama Telegraph Company, Limited. The estimated receipts for the half month ended the 15th inst., are £2,398, as compared with £1,701 in the corresponding period of 1882.

The Western and Brazilian Telegraph Company, Limited. The receipts for the weeks ending the 24th and 31st ult. and the 7th inst. were £1,896, £1,922, and £1,956 respectively, each after deducting the "fifth" of the gross receipts payable to The London Platino-Brazilian Telegraph Company, Limited.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1883.

1. "Dynamo-electric machines." F. J. CHEESBROUGH. (Communicated from abroad by E. R. Knowles, of America.) Dated Jan. 1. 6d. Consists, first, of an improved armature; second, of an improved method of combining the armature with the magnet; third, of an improved commutator; and fourth, of a combination of all the improvements in one machine.

2. "Storage batteries for accumulating electricity." F. J. CHEESBROUGH. (A communication from abroad by E. R. Knowles, of America.) Dated Jan. 1. 6d. This invention consists of a novel method of constructing a storage battery, the object of which is to expose to chemical and electrical action a larger proportion of lead surface, both metallic and oxide, and thus obtain a more powerful battery action. The improved battery consists of two or more electrodes, each of which is composed of alternate plates or discs of lead and oxide of lead piled one upon the other, each electrode beginning and ending with a plate of metallic lead, and



all of them being connected and combined into a battery. The fig. represents a top view and a vertical section of one of the electrodes, A. In these electrodes, *a*, is a disc of metallic lead, rectangular in form, and having a rectangular hole, *d*, in its centre, and a circular hole, *c*, in each of its ends. *b* is a disc of precisely the same form, made of the oxide of lead. These discs are made into a pile, as shown, and held together by means of lead rods passing through holes, *c*, and rivetted at both ends, forming the electrode.

3. "System or combination of electrical apparatus and conductors to be used in the application of electricity to practical use, &c." F. J. CHEESBROUGH. (Communicated from abroad by E. R. Knowles, of America.) Dated Jan. 1. 10d. Relates to combinations of primary or secondary batteries and other electrical apparatus for electric lighting and other purposes.

4. "Electric lamps of the arc type." F. J. CHEESBROUGH. (Communicated from abroad by E. R. Knowles, of America.) Dated Jan. 1. 6d. Consists of certain mechanical improvements in the construction of the lamp, and in the application of the circuits thereto.

5. "Electric lamps or lights of the arc type." FREDERICK JOHN CHEESBROUGH. (Communicated from abroad by Edward R. Knowles, of Brooklyn, in the County of King's State of New York, United States of America.) Dated January 1. 6d. This invention consists of a novel method of combining, adjusting, and operating the illuminating conductors of an arc light. There are two plates of carbon and an armature of an electro-magnet, which serves also to carry an illuminating conductor. This armature is made of iron, and is supported above the magnet by a pair of links, pivotted to the magnet and to the armature. The links are set at an inclination with the perpendicular, and the weight of the armature and carbon is supported upon springs and by counterweights, one spring being made to embrace an adjusting screw and the other spring being bolted to the side of the magnet and connected to the armature by means of a set screw. Weights are carried by levers fixed to the pivots of the links. There is a frame or plate of insulating material that supports the magnet, and also the other parts of the lamp. To the frame is fastened a carbon holder, into which a recess or cavity is made to receive the carbon, which is firmly held in position by means of set screws. The armature has also a square recess cut into it to receive the lower end of the carbon, which is also held into position by set screws. A branch circuit of high resistance is placed around the lamp. The lever, which is operated by the magnet, acts to introduce the resistance into the circuit when the lamp is in operation, and to cut it out when the lamp is not in operation.

6. "Incandescent electric lamps." F. J. CHEESBROUGH. (Communicated from abroad by E. R. Knowles, of America.) Dated Jan. 1. 6d. Consists generally of two parts—first, of a novel method of sealing the illuminating chamber of the lamp; second, of a novel method of making the electrical connections of the lamp.

14. "Secondary or storage batteries." T. ROWAN. Dated Jan. 1. 2d. Relates to improvements in secondary or storage batteries, whereby their weight is diminished, their cost reduced, and their efficiency increased. *(Provisional only.)*

34. "Electric lamps or lighting apparatus." W. R. LAKE. (Communicated from abroad by C. A. Hussey and A. S. Dodd, both of America.) Dated Jan. 2. 6d. Relates to improvements in electric lamps. The said invention comprises the combination with a rod for supporting a carbon, of clamping pieces controlling the movement of the said rod, an electro magnet or solenoid, an armature or core therefor, arms pivotted at one end directly to the said armature or core, and pivotted at the other end to the said clamping pieces, and stops for limiting the upward movement of the clamping pieces, so as to maintain them in position to act upon the said rod. The said invention further comprises the combination with a rod for supporting a carbon, and a clutch or locking device controlling the movement of the said rod, of two solenoids, arranged one within the other, and located, one in a main circuit, and the other in a derived circuit, and a core consisting of a cylindric or tubular piece fitting between the said solenoids. Preferably two cylindric or tubular cores are used in lieu of one, the said tubular cores being connected by an intervening piece of either magnetic or diamagnetic material.

36. "Apparatus for the generation and utilization of electric currents." S. Z. DE FERRANTI. Dated January 2. 2d. Has for its object improvements in apparatus for the generation and utilization of electric currents. The inventor uses an alternating or varying current coupled with motion to produce a current always flowing in one direction without using a commutator. *(Provisional only.)*

39. "Carbons for incandescent electric lamps." J. WAVISH and J. WARNER. Dated January 2. 4d. Relates to improvements in carbons for incandescent electric lamps, and has for its object to provide an efficient substitute for the carbon filament at present employed in lamps of this class. According to the said invention, the inventors form the carbons of a short rod or piece of carbon having thickened ends, that is to say, formed with a turn down or reduced central portion. A central hole or perforation penetrates the said carbon lengthwise, and in the aforesaid turned down or reduced central portion transverse perforations or long slots are made communicating with the said central hole. The terminal wires are or may be connected to the improved carbon at the ends thereof, and the said carbon may be used in an exhausted bulb or globe, such as is used with ordinary incandescent lamps.

46. Manufacture of incandescent electric lamps." J. R. H. WILLIAMSON and E. BÖHM. Dated January 3. 6d. Has reference to the manufacture of incandescent electric lamps, and its objects are an improved mode of mounting the platinum wires or terminals in the lamp, globe, or flask, an improved mode of securing the carbon filament or electric bridge to the platinum wires, and generally to improve the manufacture and appearance of the lamp. The inventors effect the above objects as follows:—They take an inverted ⊤, or ⊥ shaped piece of glass, which it is preferred to manufacture by flattening out one end of a glass rod, and then squeezing or folding up the flattened out portion into an approximately cylindrical form at right angles to the rod. Through the two arms respectively of this ⊥ piece they pass the lower parts of the two platinum wires, and this may conveniently be effected by melting the ends of the two arms, and then manipulating the melted glass around the wires. The wires are thus held at their lower part by the arms of the ⊥ piece, so that all liability to turn or twist together with the carbon filament is prevented. In order to secure the upper parts of the wires and to hermetically seal the neck of the globe in such a way as to avoid the leakage, which is frequently caused owing to the unequal contraction or expansion of the glass and metal, the inventors form a disc upon the upper end of the glass rod above described, by melting and flattening, and preferably before the wires are secured to the ⊥ piece as above explained, and they connect the upper parts of the wires to the disc by melting a portion of the edge of the latter, and manipulating it around the wires. They then insert the glass rod, with the wires secured thereto at the upper and lower parts, as above described, and with the carbon filament secured to the wires into the neck of the globe, and unite the glass disc to the top of the neck by a glass-blower's joint, after which the lamp is exhausted in the usual way.

49. "Dynamo-electric machines and electric motors." T. ROWAN and S. WILLIAMS. Dated January 3. 4d. Relates to improvements in the construction of dynamo-electric machines, also applicable to electro-motors, the improvements having for object to provide and combine an intense magnetic field, a very light conductor, and great velocity.

56. "Apparatus for measuring electric currents." ST. GEORGE LANE FOX. Dated Jan. 4. 6d. Relates to apparatus for measuring electric currents on the principle of the invention described in the Specification of former Letters Patent, granted and dated 14th November, 1878, No. 4,626, that is to say, in such manner that a counting or integrating apparatus, which may be of any suitable kind, is worked and controlled by the movement and position (according to the strength of the current) of the core of a solenoid, or the armature of an electro magnet, the core of which solenoid or electro magnet forms part of the circuit, or a shunted portion of the circuit, of the conductor, the current passing through which is to be measured. The present improvements consist in combining with a solenoid or electro magnet, arranged as aforesaid, and with the counting or integrating apparatus to be worked or controlled thereby, an arrangement by which the movement or position of the solenoid core or armature is made to control the flow of water or other fluid through a given passage, the fluid which flows through this passage being indicated by a gauge and the counting apparatus.

TO CORRESPONDENTS.

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Letters, &c., for the "Correspondence" columns should arrive not later than Tuesday morning if they are desired to appear in the following number, such communications to be addressed to the "Editors," ELECTRICAL REVIEW, 22, Paternoster Row, London, E.C.

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CORRESPONDENCE.

Patents for Telephones.

I observe that "Inquirer" has elicited an amended statement from Mr. Barney anent telephones, and it would now appear, upon the authority of Mr. Barney, that, on the addition of the words "held all round the edge," before omitted, his previous dictum on telephone receivers must be accepted as correct. Possibly "Inquirer" will thus be satisfied, but I fear the statement cannot yet be "held," either by centre or by edge, as being the correct "state" of the case. I cannot quite apprehend how a gentleman as famous here, upon telephone questions as the "famous Glasgow receiver" has by any possibility come to evolve such propositions. Like Inquirer, I thought of Mr. Barney's Patents, but with a different result. But I think Inquirer and others will agree with me that happily such a question rests ultimately upon the facts of the case and upon a fair common sense application of the ordinary principles of our Patent Laws. Now, a few of these facts may just at this time be worthy of especial note. I cannot vouch for the truth of what seems to rest upon fair authority—namely, that there is looming forth another telephone "case" said to affect more than one company as defendants. But if true, we may rely upon it that in such a "case" the probability is that all the telling facts and all the fair inferences therefrom will have their due consideration. From the positions of the presumed defenders and having regard to the past experience, it is unlikely that there will be any of them caught "nodding" with the consequent "grievous sin of *omission*," or faults of memory, pen or tongue. No more "sparing of the rod, &c.," as in the previous cases. And as the whole matter is also now more fully inquired into and understood, the facts formerly brought out will be made to tell more effectively with all the aid of new and important ones. And a few of these it may be well to pass in review in your ELECTRICAL REVIEW. In future papers, I should be pleased, with your permission, to contribute to the process, taking advantage of my own particular standpoint as having been associated with the previous cases. In such case, Mr. Barney may not have to complain of my not having herein touched upon the subject matters affected so grievously by his possible nod, his omission, or his dictum.

Another Inquirer.

London, *Sept. 26th*, 1883.

[We shall be pleased at any time to hear "Another Inquirer's" views on the telephonic question.—EDS. ELEC. REV.]

Seismic Disturbances.

Following on the calamitous earthquakes of Ischia and Java, if predictions be correct, is to be another of equal if not greater magnitude.

A correspondent of the *Echo* of last week, modestly signing himself "A. H.," foretells that an earthquake may be expected on or about the 22nd. It seems unfortunate that he has not disclosed how he arrives at such a conclusion, and many readers would, no doubt, express an opinion that "A. H." had simply gone "a wool-gathering," which would a few weeks' ago also have been the opinion of the writer; but later investigations and inquiries prove that we may be on the threshhold of new discoveries.

Whilst I do not profess to predict the coming earthquake, I am firmly of opinion that it is possible to tell when one is actually occurring, no matter in what part of the globe it may be.

Mr. G. Darwin in his report to the British Association last year, said: "Oscillations in the bulb of a level were observed at Pulkova Observatory, in Russia, an hour and fourteen minutes after a severe earthquake at Iquique, 7,000 miles away. Similar observations were observed twice previously, and on each occasion it was learned afterwards that earthquakes had taken place some minutes before at places more or less remote."

M. D'Abbadie, investigating earth tremors in the south of France by means of reflections from a pool of mercury, also found that there were periods of agitation and quiescence in the mercury without perceptible external cause.

Again, Professor Milne notices indirect evidence of the occurrence of earth pulsations too slow in period to be felt. For example, the earthquake which laid Lisbon in ruins, he says, produced no *perceptible* motion in the soil of Northern Europe. That there was movement, however, is proved by the fact that throughout the northern hemisphere slow oscillations of water in lakes, ponds, and canals were observed. The waters of Loch Lomond rose and fell about 2½ feet every five minutes, and other lakes were similarly agitated.

Electricians have not hitherto troubled themselves with seismic questions, but the study appears to me to be one peculiarly their own, and may be considered to class in interest with magnetic storms or earth currents.

I seldom care to rush into print, but my reasons for troubling you with this communication are as follows:—

Mr. John J. Lundy (my collaborateur) and I have for many months been making experiments on voltaic batteries, which showed a marked change during the earthquakes of Ischia and which at the time somewhat confused us. Careful notes were made in the diary of the aberrations, and when the awful results of the earthquake were made public, we discovered that the time coincided with the disturbances noted. We, therefore, determined to be on the *qui vive*, and very shortly afterwards a similar result was experienced in our tests, and we ejaculated "another earthquake!" The following morning's papers announced one in the Piræus.

We were unfortunate enough not to take notes when the Java earthquake occurred and consequently missed the opportunity of confirming for a third time our experiences.

Now, as Dr. Falb and "A. H." prognosticate another disturbance, I would recommend all interested electricians who may have a simple cell of Leclanché, Fleming's, or other battery, with galvanometer at their disposal, to examine them frequently, taking particular

notes as to "quantity" and "intensity," also the hour with the state of the barometer and thermometer.

There will probably be found an increased power during the earthquake, and, no doubt, the effects will be felt simultaneously with the eruption.

It would appear from our experiments that inorganic batteries, although not connected or joined to "earth," evidently sympathise with abrupt inorganic changes, whilst, on the contrary, our organic batteries remain uninfluenced by them.

Wm. Fereday Bottomley.

National Telephone Company, London.
Sept. 20th, 1883.

[An earthquake may affect a galvanometer or magnetic needle simply by magnetic or electrical disturbances, which generally accompany such a phenomenon, without any reference to the battery whatever, and this is a sufficiently good explanation of the apparent change in "quantity" and "intensity" mentioned in our correspondent's letter. We should be glad if Mr. Bottomley will kindly explain what he means by inorganic and organic batteries, and whether any of the cells he has experimented with would keep up a constant electromotive force for any length of time. We think that the changes noticed may have been independent of earthquakes.—EDS. ELEC. REV.]

Boats driven by Batteries.

Your correspondent, Mr. Walker, finds fault with my description of the trip taken to London Bridge from Hammersmith in the *De La Motte* as not being sufficiently nautical, and that it savours more of the "sporting reporter" than the scientific. I quite agree with Mr. Walker that it is not, nor was it intended to be, nautical, it was intended as a simple statement of facts, not as a scientific lecture; certainly the language used in it is not less scientific than Mr. Walker's "straining at gnats and swallowing camels." Moreover, I am told that the distance from Hammersmith to London Bridge is not 10 miles; in May's distance table it is given as 9 miles 1½ furlongs in a direct line, so that I could not be far wrong when I stated the distance traversed each way to be about 10 miles. I am glad to find that none of the following statements are contradicted, viz., that the *De La Motte* was the first boat on the Thames driven by primary battery; that it was the first electrically driven direct on the shaft, and that ball bearings were also first used by me for the purpose; therefore, whatever imperfections exist in the *De La Motte*—and they are numerous—these are not included. The idea of 256 revolutions (ought to have been 265) seems to be ridiculed by your correspondent; perhaps he would find the number was not so insignificant with a screw of 18″ pitch and such a load to drive in a boat where the midship section is nearly rectangular. In conclusion, I may, perhaps, be allowed to state that on a trip from Hammersmith to Eel-pie island on Thursday last, we were able to make 280 revolutions per minute, and I fully expect that in the new boat, with one of my patent motors, "we shall be able to make from six to seven miles per hour in still water with the same battery."

E. Toynbee.

18, Malvern Villas, Willesden.

Reis' Telephone described by R. M. Ferguson in "Electricity," published in England in 1867.

It will be recollected that during the trial, before Mr. Justice Fry, of the case of the United Telephone Company against Harrison Cox-Walker in May, 1882, the defendants offered in evidence a book entitled "Zeitschriftche Deutsch," containing a description and drawings of Reis' telephonic instruments. The publication of that book in England was denied by the complainants; Dr. Muirhead was the only person who testified "that he had consulted the work, and although he could not read German, was enabled from the drawings to obtain much information from it." And Mr. Justice Fry in his judgment said: "Upon the whole, though not without some doubt, I have come to the conclusion that there is evidence before me upon which I infer that the communication made in Legat must be considered to have been within the knowledge of persons skilled in these matters in this country."

Your readers will, no doubt, be surprised to learn that a full description and drawings of Reis' telephone can be found, at pages 257, 258, in a book entitled "Electricity," by R. M. Ferguson, published in London and Edinburgh in 1867, and in a second edition of 1882. This book was well known by scientific men, and is it not surpassing strange that this book was not produced at the trial?

Das Telephon.

Artificial Lines.

I feel I ought not to let pass in absolute silence the letter which Mr. F. H. Varley has addressed to you. He really ought to know that induction plates, the invention of which as well as their consequences he claims for my late brother, are more than 100 years' old. Crosse long years ago constructed a condenser of sheets of tinfoil and thin plates of mica, which he used in connection with his large water battery, consisting of 2,500 cells; a drawing and description of this condenser is given in the older editions of Noad's "Lectures on Electricity." I have the misfortune to be several years older than Mr. F. H. Varley, and I think I shall have the support of your readers and not be considered guilty of that common fault, conceit of age, if I say a certain amount of modesty is becoming when discussing what has occurred in our childhood. Now, at the period, December, 1854, which Mr. F. H. Varley speaks so confidently about, he had just attained the mature age of twelve years.

I confess to having been taken somewhat aback when I read his dogmatic assertions, for plodding people like myself feel the necessity of fortifying themselves before writing, by searching for established facts. Mr. F. H. Varley evidently does not feel this necessity; his so-called facts, to quote a sentence from his letter (which, I believe, is quite original), "proceed like Minerva from a fertile brain," and therefore he experiences no difficulty in laying down the law and in giving a full and exact account of the scientific work accomplished by his elder brothers nearly 30 years ago, at a time when, without irreverence, he may be fairly spoken of as a "small boy;" and he feels himself quite equal to describing the full scope of my communication to the Society of Arts, as well as to telling your readers what I did on that occasion. Now, as I wrote and read the paper referred to, and as I have the printed report of it to assist my memory, I think it will be conceded I am likely to be better informed, and I have to say that what Mr. F. H. Varley has stated in regard to it is *wholly* and *absolutely* untrue.

Mr. Cromwell Varley, as you have mentioned in your editorial comments, took part in the discussion of my paper. He spoke at great length, and had there been an artificial line in existence then, "doing good suit and service in the cause of electrical science," to quote Mr. F. H. Varley's own words, he would have referred to it.

Mr. F. H. Varley certainly refers to a patent taken out in December, 1854, in which condensers are mentioned. This patent, as you have pointed out, was not for artificial lines, but for what, in a subsequent patent, Mr. Cromwell Varley said was an adaptation to his double-current system of an invention of Prof. Jacobi. Mr. F. H. Varley also states that the condensers constructed by the late Mr. Varley in 1854 were "mostly made of alternate sheets of paper and tinfoil;" this could hardly have been so, as the use of paper for the insulating material would have been a *valuable* novelty and consequently it would have been claimed in the patent; but the only substances specifically mentioned are gutta-percha and oiled silk. That my late brother in 1854 tried to make condensers with paper I think is probably true, and for this reason.

When I told him in 1858 I proposed to make them with paper, he tried to dissuade me from doing so, on the ground that it would not insulate sufficiently. The secret of my success consisted in thoroughly dessicating the paper before it was immersed in the insulating material, and I had the pleasure of convincing him they could be so made by discharging in his presence my first two sets of condensers fourteen hours after they had been charged.

When the artificial line which my late brother used and exhibited was constructed (and this was several years after the Society of Arts' meeting), I rendered him all the assistance I could. I furnished him with instructions how to make the paper condensers, which were made by a workman acting under him. The resistance coils which formed part of the artificial line, and which were, I believe, the largest and most complete set which had been constructed up to that period, were made by a firm of which I was the active partner, and, acting for the firm, I made a present of these coils to my late brother. After your editorial comments it may seem somewhat unnecessary for me to enter so minutely into detail, but I feel it is only due to myself to show how baseless are the grounds of this unprovoked personal attack.

The following sentence which appears in Mr. F. H. Varley's letter "it is, indeed, quite new to me that S. Alfred Varley ever laid any claim to its invention" is true, but not in the sense implied; for I have never during my late brother's lifetime, except by describing the invention (nearly four years before he patented it) when I read my paper before the Society of Arts, publicly claimed the invention of artificial lines, and I am truly sorry that Mr. F. H. Varley, by his ill-advised letter, should have brought to light matters which, without disadvantage to anybody, might have been allowed to remain shrouded in comparative oblivion.

S. Alfred Varley.

The late C. F. Varley.

It is sometimes difficult in upholding the merits of the dead to avoid wounding the susceptibilities of the living, yet it is also unfair for the living to attack or impugn the honoured memory of the dead, when the voice is silent and the lips sealed for ever. To continue the battle of rival claims would involve my entering into the lists in a partisan spirit. This I particularly desire to avoid. I therefore confine my observations to your editorial footnote. Notwithstanding your remarks in reference to S. Alfred Varley's paper read before the Society of Arts in 1859, and the perusal you have made of Cromwell Fleetwood Varley's patents, I still adhere entirely to the text of my letter. I write from personal knowledge from being engaged in assisting in the manufacture of the elementary artificial line as used by S. Alfred Varley, and upon the subsequent apparatus supplied in accordance to Cromwell Fleetwood Varley's specification, and made by the firm of Cornelius and S. Alfred Varley, the whole of the resistance coils of which were adjusted and finished by myself. I see that in a contemporary S. Alfred Varley lays claim to the invention of the artificial line. This is the first time I have heard of it, inasmuch as he never made any such pretension, that I am aware of, during the years we worked together, nor indeed to any other members of the family, a fact which is somewhat remarkable.

Let me, however, not be misunderstood. I do not wish to detract from the share of credit to which S. Alfred Varley is justly entitled from the papers he read before the Institute of Civil Engineers and the Society of Arts, all of which contributed to make clear the promise science afforded to the commercial fulfilment and realisation of Atlantic telegraphy.

Frederick H. Varley.

P.S.—I would also draw your attention to page 11 of Cromwell Fleetwood and Cornelius John Varley's patent of 1859, line 12, and though the patent was applied for in June, 1859, my father, Cornelius Varley, being the patent agent, S. A. Varley never claimed that Cromwell was infringing upon his invention, as he surely would have done had he a fair ground then. *Now* that he is dead the claim comes too late.

Mildmay Park Works,
Mildmay Avenue,
Sept. 22nd, 1883.

[We would call our correspondent's attention to the letter of Mr. S. A. Varley, and also to the extract from the paper read before the Society of Arts (see our other columns), and we would suggest that this subject be no further discussed, as, in our opinion, the evidence now before our readers is ample for an unbiassed judgment to be formed as to the true originator of artificial lines. In reference to Mr. Varley's postscript, it is only necessary to remark, that Mr. S. A. Varley's paper was read on the 30th *March*, and that patent agents are not usually in the habit of divulging their clients specifications, even when the parties are related. —EDS. ELEC. REV.]

Terrestrial Magnetism and Railway Travellers.

The above title will perhaps appear as being rather extraordinary, although, I venture to think, after the matter has received a little thought, such a connection as terrestrial magnetism and railway travellers will not seem such an unwarrantable coupling as at first sight it appears.

It is well known that travelling by rail has a marked effect on some persons, and a long journey is found to be more or less fatiguing to most people. Whether the temporary fatigue so produced is, in the long run, beneficial or detrimental to the human system I leave for others to decide, the object of this letter being more to draw attention to the possibility of the nervous system being considerably affected when travelling at high speeds and in certain directions under the influence of terrestrial magnetism rather than to decide on the possible advantages of such an effect. The earth itself has been compared to, and is supposed to be a huge magnet. That it develops lines of magnetic force is well known, and can be proved in a variety of ways. These invisible lines of force give direction to the magnetised needle, and Faraday and Barlow showed that by moving an electrical conductor in certain directions under terrestrial magnetic influence a sensible current of electricity was obtained. We are then enveloped by these ever present invisible lines of magnetic force, and the question arises whether the human system, consisting as it does of substances —although apparently non-magnetic, are found to be capable of conducting electricity—whether it is not effected like all other electrical conductors when moving across the lines of magnetic force, the effect produced being proportional to the speed of the conductor. There can be no doubt that a current must be produced in a closed conductor when moving under such conditions, no matter whether the conductor consists of nerve fibre, muscle, or a copper wire.

The nerve fibres of the human system have been compared to telegraph wires by more than one great authority, and they are well known to be comparatively good conductors of electricity. If, therefore, they are capable of conducting electricity, they should also be capable of *generating* that force when cutting the lines of terrestrial magnetic force, according to the well-known law of the mechanical generation of electricity.

Now, when a person is travelling by rail from London to Bristol he is actually cutting the lines of terrestrial magnetic force at a speed of fifty miles an hour; about twice the velocity of the movable conductor or armature of a Gramme dynamo-electric machine. Such being the case, is it not very probable that the nervous system is considerably affected when travelling at high speed under the influence of terrestrial magnetism?

E. L. Voice.

London, *September* 22, 1883.

[We are afraid that if we attempted to answer Mr. Voice at length we should be obliged to become jocular, and we therefore prefer to let his communication stand as it is.—EDS. ELEC. REV.]